Discussion Paper

THE EFFECTS OF WAGE INDEXATION ON THE MACRO- ECONOMIC PERFORMANCE OF A SMALL OPEN ECONOMY

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THE EFFECTS OF WAGE INDEXATION ON THE MACRO- ECONOMIC PERFORMANCE OF A SMALL OPEN ECONOMY

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Preface

From time to time, Labour Canada commissions studies which deal with problem areas related to wages and labour. This study covers a broad range of theoretical and practical issues, but the main theme is the exploration of the effects of wage indexation on the macroeconomic performance of a small open economy (SOE) such as Canada.

The SOE is characterized by a two-sector model in which the relative price of nontradables is an important internally determined variable. It is assumed that the performance of an SOE differs markedly under flexible exchange rates and fixed exchange rates. The effects of indexation are established by comparing the impact of various changes in two models, identical in every respect except for the process by which wage rates are determined. One model incorporates full and immediate adjustment of wage rates to maintain a constant real wage in the face of price increases as would occur with indexation. The other model allows nominal wages to adjust partially to price increases in the event of predictable policy changes or not at all in the event of unpredictable changes in the economy. Most of the analysis is formulated in terms of once-and-for-all price increases, but this assumption makes little difference to the conclusions.

The main conclusion of the study is that wage indexation is a mixed blessing: it provides superior results compared to non-indexation in some sets of circumstances but

inferior results in others. It has many of the same attributes as "built-in stabilizers" or "monetary rules" which require no active intervention for their operation and hence are not subject to human error. But it also introduces an element of inflexibility at times when deliberate judgment, despite the possibility of errors, is required for the best solutions.

In more detail, the principal effect of wage indexation is to maintain a constant real wage in the face of price changes. With a constant real wage, firms will maintain a given level of employment and output. As a result, the aggregate supply curve is vertical creating a dichotomy between the price level on the one hand and real variables such as employment and output on the other hand. This is a desirable feature of indexation if the main purpose is to defend existing levels of employment and output. In other words, indexation insulates against purely monetary events; no matter how high or variable the rate of inflation, no matter how difficult it is to predict inflation rates for two- or three-year labour contracts, indexation protects wages against these economic uncertainties.

But the main difficulty with indexation is that it cannot discriminate between inflation when the real wage should remain constant and other situations where an increase or decrease in real wages is required. It is all too evident

that indexation cannot be turned on and off as these circumstances vary.

While the Canadian economy has been dominated by inflationary pressures during the last decade or more, other economic events are also important to the wage-determination process. For instance, the sizeable depreciation of the Canadian dollar during 1977 and 1978 has undoubtedly contributed to increases in the cost of living. With indexation, nominal wages adjust to offset the reduction in real wages caused by the depreciation.

In view of the ambivalence towards indexation raised by the analysis in this study, Professor Prachowny asks whether the government should encourage or discourage COLA* clauses in private-sector labour contracts? His answer is that the government should take a neutral stance. It should leave the decision to the bargaining process because the self-interest of the bargaining opponents tend to coincide with the interest of the economy as a whole. At times when inflation is the dominant factor in labour negotiations, both unions and management can see tangible benefits from indexation and it is likely to be incorporated in labour contracts, thus providing the insulation of the real economy from the inflationary

* Cost of living allowance

effects. On the other hand, when relative price shifts or productivity changes are important elements of the bargaining environment, unions and management have a disincentive for indexation.

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1. INTRODUCTION

In retrospect, the feature of greatest economic significance concerning the inflationary experience of the last decade has not been its intensity but its variability. Starting from a base of barely noticeable growth in the Consumer Price Index during the 1950s and early 1960s, the inflation rate jumped from 2.9 per cent in 1971 to 10.9 per cent in 1974. Thereafter, it fell from 10.8 per cent in 1975 to 7.5 per cent in the next year, rising once more to 9.0 per cent in 1978. Among other effects, variability of such proportions prevents accurate predictions and frustrates carefully worked out economic decisions involving long-term contracts. As an alternative to the complete elimination of such contracts or the use of barter trade, contracts that are indexed to a general price index are frequently invoked. Indexation has been proposed in a wide variety of situations. In Canada, the income tax incorporates indexation as does the old-age pension by virtue of federal legislation enacted in the past decade. Also, a number of union contracts signed each year contain cost-of-living allowances. In addition, indexation of bonds and other debt instruments has been adopted in some countries such as Brazil.

Not surprisingly, the issue of indexation becomes most pressing at times of high and variable inflation. Inflation rates that are low and stable are more easily

predicted, and even if not, the costs of errors are not large. But with the price level rising at an unpredictable rate, indexation is often seen as a means of reducing the social tensions created by the effects of inflation on rates of return to any kind of economic activity, most particularly, work effort. Proponents of indexation claim that it can eliminate some of the more painful redistributive features of unanticipated inflation. A long-time advocate, Friedman (1974) has also suggested that indexation provides an environment in which anti-inflationary measures are less likely to have undesirable side effects on output and employment and thus are politically more attractive. But indexation is not without its critics. The general argument against indexation is that it cannot hope to eliminate all the redistributive effects of inflation and that its widespread adoption would take away the incentive for governments to deal with inflationary pressures emanating from their own activities.

As with many other policy options, indexation remains controversial and governments are justifiably uncertain whether they should encourage or discourage this form of inflation insurance. In Canada, the federal government seems to have taken a positive attitude towards indexation in the public sector: not only are income taxes and old-age pensions indexed, as previously noted, but some public-service union contracts and pensions are also indexed. On the other hand, it has not taken a legislative stand on indexation

in the private sector, compared with Australia, for instance, where quarterly cost-of-living adjustments were made to the "basic wage" by the Conciliation and Arbitration Commission during the period 1923 to 1953. [See Australia, Department of Labor and Immigration (1975) for an account of this practice.]

1.1 An Outline of the Study

The major purpose of this study is to investigate the role of wage indexation in achieving the macroeconomic goals of stable prices and full employment. Does indexation make it easier or more difficult to achieve these macroeconomic goals? A related question is: Should the government encourage or discourage indexation in labour contracts? The answer to these questions depends very much on one's perception of the current performance of the economy. On the one hand, the economy may be operating under optimum conditions with "acceptable" rates of unemployment and inflation and the government wishes to protect the economy from random shocks that would bring about departures from this position. In this protective environment, any shock is considered undesirable and the macroeconomic goal is to insulate the economy from such shocks. On the other hand, the authorities may be attempting to establish an activist environment because the economy is operating below "par" and policy initiatives to influence aggregate demand are necessary to achieve optimum performance.

Under these various conditions what difference does the introduction of wage indexation make? The basic role of wage indexation is to make output supply-determined since, as will be shown later, indexation converts a positively sloped aggregate supply curve to one that is vertical. In this light, one can foresee that indexation will hinder aggregate demand policies that attempt to overcome a recession but it also increases the effectiveness of such policies in an anti-inflationary setting. [See Fischer (1977, p. 133) for a similar conclusion.] In a protective environment, indexation is beneficial when random shocks are transmitted through aggregate demand but harmful when unexpected fluctuations are on the supply side of the economy.

In terms of recent experience, indexation would have been desirable in the face of the unexpected worldwide inflation of the 1970s or, at present, if a reduction in inflation at the existing unemployment rate is the primary objective. But indexation is undesirable if oil-price increases generated by OPEC actions over the last eight years are considered to be the most important of external influences on the Canadian economy because these are essentially supply-side considerations or if a reduction in the current employment rate is of greatest concern to the policy makers.

As a consequence it is not possible to offer a general answer to the twin questions: Does indexation help to achieve macroeconomic goals? and should the government

use moral suasion or legislation to persuade the private sector to incorporate wage indexation in labour contracts? Nevertheless, as will be made clear in the subsequent analysis, there appears to be a coincidence of social goals and private incentives. In those instances where indexation is desirable for its role in achieving macroeconomic goals, both parties to a labour contract tend to find indexation is in their own best interests, but in instances where indexation is harmful to the desired macroeconomic performance, these incentives become weaker or turn into disincentives. Therefore, there is at least a presumption that market forces will provide the "right" solution for the economy and that legislative remedies are not required.

1.2 The Research Strategy

The basic strategy for the analysis is to develop a macroeconomic model in which wage indexation is absent and compare the effects of exogenous changes on prices and output with an equivalent model in which indexation has been introduced. In this way it will be possible to assign certain effects to indexation per se. This is the procedure adopted in much of the literature on wage indexation, of which Gray (1976) is the most prominent example. However, most of the analysis has been developed for closed economies, paying little attention to the special features of an open economy. Since Canada is characterized by the fact that a significant

portion of its goods and assets is bought or sold in international markets at given prices, it is important to incorporate these behavioural and structural characteristics into the model.

The analysis is limited to an evaluation of wage indexation, leaving out of account indexation in other areas such as taxes, financial instruments or pensions. Furthermore, the study will probe theoretical and policy issues; its conclusions will be qualitative and not quantitative. No empirical work will be attempted because it is virtually impossible to find labour contracts that are identical in every respect, except for indexation and thus the effects of indexation cannot easily be quantified.

1.3 The Trend of Real Wages

To get an overview of the impact of inflation on wage earners -- and indirectly to establish the importance of the subsequent analysis -- it is useful, first of all, to present data on the trend of real wages during the years of 1968 to 1978, a period of unprecedented inflationary experience. The data are presented in Table 1.1. Nominal wage increases are represented by the first year of wage settlements covering base rates negotiated during each year. These figures reflect the outcome of bargaining during that year and thus incorporate the effect of labour-market conditions prevailing at the time as well as anticipations of inflation for the first year of the contract. Compared with other time

Table 1.1

Nominal and Real Wage Increases, 1968-1978
(Percentage changes)

Year	Wage settlements, increase in first-year base rates, all industries except construction (1)	Consumer price index, all items, 1971=100 (2)	Increase in real wage (1)-(2) (3)
	%	%	%
1968	10.0	4.0	6.0
1969	9.5	4.6	4.9
1970	10.4	3.3	7.1
1971	9.3	2.9	6.4
1972	9.2	4.8	4.4
1973	11.4	7.5	3.9
1974	17.0	10.9	6.1
1975	21.1	10.8	10.3
1976	12.3	7.5	4.8
1977	8.0	8.0	0.0
1978	7.2	9.0	-1.8

Source: Labour Canada, Wage Developments Resulting from Major Collective Bargaining Settlements (Excluding the Construction Industry).

Bank of Canada Review, April, 1979, Table 62.

series on wages, such as "Average Weekly Earnings", these data are the best for our purpose, but of course, they do not include the (unknown at the time) amounts paid out in COLA clauses during the contract. Set beside the percentage increase in the Consumer Price Index (second column of Table 1.1) we see that both nominal wages and prices have rising rates of growth from 1968 to 1975, falling thereafter until 1978. But the third column exhibits a pattern indicating that increases in the real wage declined as inflation accelerated during the early 1970s. Of course, one is not entitled to conclude that this was due to a systematic underestimation of the inflation rate without considering all the other factors that determine wage increases and without a firm knowledge of the expectations process at work during that time, but the pattern is not inconsistent with that hypothesis. As inflation rates peaked in 1975, the rate of increase of real wages rose for that year, but for the last three years, the rate falls and becomes zero in 1977 and negative in 1978. The deteriorating labour market and the constraints imposed by the Anti-Inflation Board have a bearing on these results, but it is also possible that contracts negotiated during these years incorporated too optimistic a view about future inflation. It is difficult to predict -- despite the overwhelming temptation -- the wage patterns that would have occurred if all contracts had incorporated full indexation, but it is at least possible to speculate -- and only

speculate -- that the "bulge" of 1974 and 1975 would have been reduced and that the pronounced drop in wage increases in 1976 to 1978 would not have materialized. Thus indexation might have had its main impact on influencing the timing but not the size of wage increases. In effect, indexation is unlikely to lead to consistently higher or lower wage increases compared with a situation where expected inflation is an important determinant, but it is likely to provide a smoother adjustment path as inflation rates change because errors in anticipations are eliminated from the wage determination process.

1.4 Wage Indexation in Canada

So as to put the remainder of the study in perspective, data on the extent of COLA clauses in wage contracts in Canada over the past few years are presented and the most important characteristics of these COLA clauses are discussed in this section. Observations are drawn primarily from data released by Labour Canada in the publication, Research Bulletin on Cost-of-Living Allowance Data (and other titles) for 1973, 1974, and 1976, with preliminary tables for 1977, 1978 and the first half of 1979, and unpublished estimates of the potential effects of COLAs on base rate increases at selected CPI projections. Supplementary information is gleaned from The Current Industrial Relations Scene in Canada, 1978, a compendium of statistics on industrial relations in Canada, produced by the Industrial Relations Centre at Queen's University.

1.4.1 The Extent of COLA Clauses

Table 1.2 presents data on the incidence of COLA clauses both in terms of the number of agreements signed in any one year and employees covered. Nineteen seventy-five seems to be the peak for the inclusion of COLA clauses, perhaps not surprisingly, since that year may well have had the greatest uncertainty about future inflation rates. There was a sharp drop in settlements with COLA clauses negotiated in the years 1976 to 1978. Indexation, according to The Current Industrial Relations Scene in Canada (p.322) was dropped or made inoperative in 1977 in about 150 out of a total of 450 contracts with such provisions in 1976, presumably because such clauses would have exceeded the guidelines of the Anti-Inflation Board. Early estimates for 1979, however, show a resurgence of COLA clauses as the AIB was phased out and as inflation again accelerated.

Table 1.3 compares recent increases in wages (base rates) for settlements without COLA clauses and those that contain such provisions. In almost every instance, the increase is higher in those contracts without COLA, but one is not entitled to conclude that COLA clauses reduce the total size of wage settlements because the increases shown in the table do not include the payments that are subsequently made when COLA clauses require automatic increases in nominal wages. As a result, those contracts that incorporate indexation could have overall wage increases that are larger than those without. (See Section 1.4.3 for estimates for 1979.) Not

Table 1.2

The Incidence of COLA Clauses in Collective Agreements Negotiated in the Years 1974-79

	1974	1975	1976	1977	1978	1979*
1. Total Number of Agreements Negotiated	846	1 116	1 250	577	674	294
2. Total Number of Agreements with COLA Clauses	199	356	272	133	160	88
3. Percentage of Total Agreements with COLA Clauses	23.5	31.9	21.8	23.1	23.7	29.9
4. Total Number of Employees Affected by Collective Agreements (thousands)	995	966	1 344	1 041	1 310	579
5. Number of Employees Covered by COLA Clauses (thousands)	283	352	390	243	289	200
6. Percentage of Employees Covered by COLA Clauses	28.4	36.4	29.0	23.3	22.1	34.5

*To June 30, 1979.

Source: Labour Canada, Research Bulletin on Cost-of-Living Allowance Data, 1974, 1975, 1976, Table C-1; preliminary Table B-1 for 1977, 1978 and 1979.

Table 1.3

Wage Increases in Settlements With and Without COLA Clauses 1974-78

(Average annual percentage change in base rates over life of contract)

	1974	1975	1976	1977	1978
All agreements without COLA	14.6	19.1	11.0	7.9	7.2
All agreements with COLA	14.0	14.0	8.8	7.1	6.1
One-year agreements without COLA	16.3	20.2	11.2	8.0	7.1
One-year agreements with COLA	15.9	22.9	9.6	7.8	6.1
Two-year agreements without COLA	13.9	17.1	10.2	7.0	7.3
Two-year agreements with COLA	13.9	15.9	10.0	7.3	6.8
Three-year agreements without COLA	12.8	12.3	10.7	8.7	7.2
Three-year agreements with COLA	8.1	11.0	8.1	4.4	3.8

Source: Labour Canada, Wage Developments Resulting from Major Collective Bargaining Settlements (Excluding the Construction Industry)

only should increases in base wage rates of contracts with COLA clauses be smaller than those of contracts without COLA provisions, they should also be less responsive to changes in the inflationary experience over time. While it is not unexpected that wage increases in contracts without COLA should accelerate up to 1975 and decline thereafter in conformity with actual or predicted inflation, contracts with COLA should display a greater constancy in the face of changes in the inflation rate. Cursory examination of the data in Table 1.3 seems to suggest that this is not the case. Contracts with COLA clauses of one, two and three years duration appear to be just as responsive to the changing patterns of inflation as those contracts without COLA clauses. Of course, it is not possible to hold all other factors constant and thus no firm conclusion on this point can be drawn without further investigation.

1.4.2 The Characteristics of COLA Clauses

While there is great variety in COLA clauses, some being designed for particular situations, the majority contain a specific formula providing for an amount and timing of payments in relation to increases in the Consumer Price Index. Most provisions call for allowances in addition to the negotiated pay rates, but they usually do not form part of the regular rate. The cost-of-living allowance, in this insurance, is referred to as a "float" or "floating allowance" and does

not apply to overtime rates or other premia. When a portion or all of the allowance is incorporated into the wage schedule, it is generally referred to as a "fold" or "fold-in".

Cost-of-living allowances are limited in some agreements to a maximum amount per period or during the life of the contract; this limit is referred to as a "cap". On the other hand, COLA clauses sometimes provide a minimum guarantee regardless of how little the CPI rises. Some COLA provisions are written so that the COLA payment does not take effect until a minimum increase in the CPI has been reached; this is usually referred to as a "triggered" or "threshold" clause. A few agreements do not specify the COLA formula to be used but provide only for the reopening of wage negotiations if the CPI increases by a certain amount. (See Table 1.4, line 4.) The majority of agreements use the all-items, all-Canada CPI as a basis for measuring cost-of-living increases; however, a few use a city or regional index or a combination of two or more indices.

As can be seen from Table 1.4, most COLA formulae are of the "cents-per-point" variety, but over the period 1974-79 a definite trend towards proportional changes (line 3) has been established. The distribution of the "cents-per-point" formulae is shown in Table 1.5, both by contracts negotiated and employees covered. The single most popular provision is 1¢ in the range of .30 to .39 points increase in the CPI (line 2). In early 1979 this provision was included in 77.4 per cent of the contracts covering about 63 per cent of the employees.

Table 1.4

Method of Calculating Cost-of-Living Allowances for Agreements Signed in the Years 1974-79

(Percentage of all agreements with COLA clauses)

Type	1974	1975	1976[1]	1977	1978	1979[2]
1. Cents per Point Increase in CPI	80.9	67.4	46.3	33.9	44.4	47.2
2. Cents per Percentage Increase in CPI	5.0	6.5	2.9	3.6	3.2	2.7
3. Percentage Increase in Wages/Percentage Increase in CPI	11.1	19.4	27.2	40.7	30.8	48.2
4. COLA to be Negotiated if Necessary	1.1	2.0	1.8	-	11.9	-
5. Method of Calculation not Given	4.0	2.5	14.0	21.7[3]	10.0[3]	1.8[3]

[1]Additional category listed for 1976 data: COLA clause to be in effect only if AIB terminates (no other details): 5.5%.

[2]To June 30, 1979.

[3]COLA Clauses inoperative (no other details).

Source: Research Bulletin on Cost-of-Living Allowance Data, 1974, 1975, 1976, Table C-4; preliminary Table B-4 for 1977, 1978 and 1979.

Table 1.5

Cents-per-Hour COLA per Point Increase in the CPI for Agreements Settled in the Years 1974-79

(Percentage of agreements with this provision and employees affected in parentheses)

Provision	1974	1975	1976	1977	1978	1979[1]
1. 1¢ per 0.20 - 0.29 Increase in CPI	n.a.	2.1 (13.0)	x (x)	8.8 (4.5)	6.0 (3.2)	3.8 (5.4)
2. 1¢ per 0.30 - 0.39 Increase in CPI	25.5 (39.8)	35.5 (36.7)	41.3 (48.1)	66.7 (78.9)	74.7 (82.1)	77.4 (62.8)
3. 1¢ per 0.40 - 0.49 Increase in CPI	26.1 (22.2)	19.6 (29.6)	16.7 (16.3)	10.5 (7.2)	3.6 (2.8)	13.2 (29.8)
4. 1¢ per 0.50 Increase in CPI	27.3 (23.8)	26.7 (11.7)	18.3 (25.1)	7.0 (3.8)	10.8 (9.7)	1.9 (0.7)
5. 1¢ per 0.60 Increase in CPI	3.1 (3.0)	1.7 (1.0)	1.6 (x)	x (x)	1.2 (0.6)	x (x)
6. Varies during Life of Contract	5.0 (1.8)	1.3 (x)	4.6 (6.3)	7.0 (5.6)	3.6 (1.6)	3.8 (1.4)
7. Other	13.0 (9.4)	12.5 (6.4)	16.7 (3.5)	x (x)	x (x)	x (x)
TOTAL:						
Number of Agreements	161	240	126	57	83	53
Employees affected	202 850	221 195	123 110	82 505	128 340	94 565

[1]To June 30, 1979.

x - less than 1 per cent.

Source: Research Bulletin on Cost-of-Living Allowance Data, 1974, 1975, 1976, Table D-1; preliminary Table B-5 for 1977, 1978 and 1979.

The frequency with which COLA payments are made also varies widely, with quarterly payments (45 per cent of all COLA clauses in 1974 and 41 per cent in early 1979) losing ground to annual payments (45 per cent in early 1979 but only 12 per cent in 1975), a somewhat surprising development in view of the high rates of inflation which suggest more, rather than less, frequent adjustments to keep real wages constant. Very few workers (0.6 per cent in early 1979) are covered by monthly payments.

1.4.3 The Degree of Indexation

Wages are considered to be fully indexed if the percentage change in wages as a result of a COLA payment equals the percentage change in the Consumer Price Index over the same period. This means that the COLA provision fully compensates workers for the reduction in their real wage caused by increases in the cost of living. Since many contracts use the "cents-per-point" principle in calculating COLA payments it is difficult to determine the degree of indexation. However, it is possible to calculate the hourly wage at which different "cents-per-point" formulae would provide full indexation and then determine how that wage compares with what is actually paid. Table 1.6 shows these calculations based on quarterly COLA payments for the period 1974 to 1978. Since 1¢ per .20 points of the CPI provides better coverage than, for instance, 1¢ per .5 points the wage for which full indexation applies is higher for the former than the latter. Also, it can be seen that any given formula

Table 1.6

Hourly Wage Rate Corresponding to "Full Indexation" for Quarterly Changes in CPI During the Years 1974-78 According to Various "Cents-per-Point" Formulae

Year and Quarter	(Average Hourly Earnings in (Manufacturing)	COLA Formula (cents per point) 1¢/.20	1¢/.30	1¢/.40	1¢/.50
		$	$	$	$
1974	($4.37)				
I		5.89	3.93	2.95	2.36
II		6.25	4.17	3.14	2.50
III		6.40	4.28	3.20	2.56
IV		6.60	4.40	3.30	2.64
1975	($5.06)				
I		6.67	4.44	3.33	2.67
II		6.94	4.61	3.47	2.78
III		7.14	4.76	3.57	2.85
IV		7.18	4.75	3.63	2.87
1976	($5.76)				
I		7.08	4.67	3.54	2.83
II		7.35	4.88	3.71	2.94
III		7.50	5.00	3.75	3.00
IV		7.67	5.13	3.87	3.07
1977	($6.38)				
I		7.80	5.20	3.92	3.12
II		8.13	5.42	4.08	3.25
III		8.00	5.94	4.00	3.20
IV		7.78	5.17	3.89	3.11
1978	($6.83)				
I		8.50	5.65	4.25	3.40
II		8.78	5.86	4.41	3.51
III		8.89	5.89	4.44	3.56
IV		8.95	5.95	4.47	3.58

Source: Bank of Canada Review, April 1979, Table 63 for average hourly earnings in manufacturing.

requires an increasing wage to maintain full coverage because the percentage change in the CPI is getting smaller. Compared with the average hourly wage in manufacturing for each year (in parentheses in Table 1.6), COLA formulae represented by the last three columns would be insufficient to provide full indexation; only the formula of 1¢ per .2 points (5¢ per point) or somewhat less would maintain the average real wage in manufacturing industries. However, from Table 1.5, line 1, it is evident that very few contracts have such generous coverage. On the basis of this evidence we are able to conclude that most COLA clauses provide only partial indexation.

Other recent unpublished evidence corroborates this conclusion. Starting with the first quarter of 1979, the Economic Analysis Branch of Labour Canada estimates the value of COLA payments under different assumptions of inflation rates. There were 107(184) contracts negotiated during the period January to March (April to June) 1979 of which 28 (47) contained COLA clauses. Base wage rates increased 5.3 per cent (7.9 per cent) for those contracts with COLA clauses compared with 8.1 per cent (8.2 per cent) for those without. If inflation turned out to be 8 per cent, COLA payments would add another 4.4(3.1) per cent to overall wage increases. On the basis of these estimates and also for 6 per cent and 10 per cent projected inflation, Wage Indexation Factors (WIF) were calculated. Full indexation requires a WIF of one, but

for the first two quarters they ranged from a low of .23 to a high of .54 indicating once more, that COLA seem to provide only partial compensation for inflationary effects on wages.

1.5 The Dimensions of Wage Indexation

In order to introduce as much precision as is possible into the analysis, a number of assumptions about the indexation scheme to be used in this study must be specified.

(i) Wage indexation is incorporated into labour contracts between firms and unions voluntarily because both sides see some benefit from such a provision.

(ii) Wage indexation is an additional feature in contracts; it is not a substitute for other provisions, such as fringe benefits or working conditions. Although it is quite possible that management accepts indexation as a trade-off against the abandonment of some other union demands during the bargaining process, such outcomes are difficult to analyse because it is no longer possible to identify the effects of indexation, ceteris paribus. As a result, in the remainder of the study, all other aspects of a labour contract are taken to be invariant with respect to indexation.

(iii) Wage indexation takes the place of provisions for anticipated inflation or compensation for past inflation. Again, it is possible for actual contracts to contain combinations of indexation, anticipations and "catch-up" in an attempt to prevent erosion of the real wage during the life of a contract, but the analysis must proceed on the assumption that indexation is a substitute for these other measures so as to make the distinction between wage determination without indexation and with indexation as clear as possible.

(iv) The only wage indexation scheme to be considered is one that is complete and immediate. In fact, as we have seen, most COLA clauses are partial and involve some time lags, but this choice is again made on the basis of putting the role of indexation in sharp relief. If a more "realistic" assumption were made, it would no longer be possible to suggest that indexation is a substitute for ex ante and ex post adjustments of wages to prices. Thus assumptions (iii) and (iv) are linked together. As a consequence, wage bargains are assumed to involve a basic

nominal wage determined by labour-market conditions plus an allowance for a one-per cent increase in this nominal wage for every one-per cent increase in a general price index, changes in that price index being announced continuously.

(v) Indexation can only be stipulated in a binding legal union contract and therefore wage bargains involving nonunion labour are excluded from the analysis. It is, of course, quite possible for nonunion wages to keep in close relationship to those negotiated in union contracts and also that verbal agreements exist on COLA payments between employers and employees, as groups or as invididuals, but unless these "agreements" can be enforced in a court of law, they are likely to be reinforced by demands for *ex ante* or *ex post* compensation for inflation which would violate the previous assumption.

These assumptions have one element in common: they are designed to make it possible to identify the independent effect of indexation on the macroeconomic performance of an economy subjected to policy changes or random shocks. While these assumptions typically do not accord with the facts, it

would be analytically sterile to design a model where indexation is a complement to other counter-inflationary provisions in which case only the joint effect can be isolated or to design a model where indexation is incomplete and subject to lags in which case it becomes observationally equivalent to wage determination with price expectations.

One exception to this strict set of assumptions will be considered, where appropriate. Since COLA clauses tend to be inoperative when prices fall, the analysis will allow for this asymmetry: full indexation for price increases and a complete absence of indexation for price decreases.

2. THE CHARACTERISTICS OF A SMALL OPEN ECONOMY

2.1 The Concept of a Small Open Economy

The dimensions of a small open economy (SOE) are drawn in terms of economic characteristics and not in terms of physical size. An SOE is defined, analogously to a perfectly competitive firm, to be a price taker in all international markets in which it buys or sells. Whether the country is large or small in size or population is irrelevant. It is quite possible to think of physically small countries as having market power in international transactions; Saudi Arabia, with a population of only six million, is certainly not a price taker in the oil market. But it is also possible to think of large countries, such as China, that have little or no impact on prices in international markets.

So as to distinguish it from other economic entities, the term "open" in small open economies implies that international transactions are of considerable importance relative to purely domestic transactions. "Considerable" cannot be defined any more precisely than "large enough to matter to the whole economy." The term "small" then implies price-taker behaviour in international transactions.

Because it is often used but rarely explained, price-taker behaviour of SOEs needs further elaboration. In international markets for homogeneous commodities or assets, an SOE can buy or sell as much as it wants without influencing

the price in the market because its additional demand or supply is infinitesimally small compared to existing world quantities traded. At the same time, a change in world market conditions that results in a change in the world price must be absorbed by an equal price change at home. In essence, an SOE cannot impose its "view" on the rest of the world but the reverse is mandatory.

Nevertheless, it is unrealistic to insist that an SOE buys and sells only in international markets. There are likely to be a number of markets in which impediments to international arbitrage are sufficiently strong so as to create segmented, national markets. Transportation costs, tariff barriers or controls on capital flows may be the source of these impediments in which case the domestic price may be unrelated to the international price over a given range. For instance, the domestic price of cement, for which transportation costs are considered to be high in relation to value, may be higher or lower than the international price, the upper limit being the international price plus the cost of shipping cement into the SOE and the lower limit being the international price minus the cost of shipping from the SOE to world markets. Thus the range in which the domestic price is free to move is twice the transportation costs of the commodity. If the domestic price had a tendency to move above the upper limit, it would be profitable for foreign suppliers to ship

cement to the SOE, hence preventing the price from rising above this limit. Symmetrically, any tendency for the domestic price to go below the lower limit creates profitable opportunities to export cement.

This sharp distinction in behaviour between international and domestic markets implies an equally sharp assumption about the existence of impediments: they exist in those markets that are isolated from world competition but are completely absent in international markets. But such an assumption is not necessary; the division of all markets into international and national is consistent with a continuum of impediments. An SOE will be a price taker and therefore a participant in international markets even if impediments are relatively large as long as the domestic price would have been higher than the upper limit imposed by the world price plus the cost of overcoming the impediments or below the lower limit of world price minus the cost of the impediments. In these cases, the domestic price is not necessarily equal to the world price but it must move in line with it. Hence price-taker behaviour prevails in these markets. In purely domestic markets, the price lies between the upper and lower limits and is free to move within the limits.

2.2 The Markets in an SOE

A general-equilibrium macroeconomic model of an SOE must include a description of the functioning of commodity, factor and asset markets. The following list of markets and their characteristics gives us an overview of the structure of an SOE:

Market	Characteristics
Commodities	
- exportables) - importables)	- international markets, SOE is price taker
- nontradables	- domestic market, SOE is not a price taker within a given range
Factors of Production	
- labour) - capital)	- internationally immobile, rates of return determined domestically
Assets	
- money	- only held by domestic residents, exchange rate determined by domestic and world variables
- bonds	- foreigners consider SOE bonds to be perfect substitutes for their own, interest rate determined in world markets.

Commodities are not divided, in the customary fashion, into consumer goods, investment goods, etc., but instead are distinguished according to their price determination. Exportables represent the domestic output of all goods for which the domestic price would be lower than the lower

limit set by the world price. This market is characterized by excess domestic supply at given world prices. Importables, on the other hand, represent the domestic output of those commodities that compete with imports and their price is at the upper limit. The characteristic here is excess demand. Given world prices of exportables and importables it is possible to aggregate these into a composite commodity called tradables. For nontradables, domestic output is equal to domestic absorption and this equilibrium condition implies price determination in the domestic market. As long as the relative price of exportables and importables is constant we can reduce the number of commodity markets to two: - tradables, a quantity-adjusting market with prices treated as exogenous and nontradables where both prices and quantities are endogenous. As we shall see later, this two-sector representation of an SOE has important implications, for both analytical and policy purposes.

In international trade models it is customary to treat factors of production as internally mobile but internationally immobile. In that case, rates of return to these factors are determined within the country and are uniform in all sectors. But factors of production should not be treated as nontradables, immune to shocks from world markets. Because factor and commodity prices are linked through the process of minimizing costs or maximizing profits, these factor prices

are indirectly influenced by the world prices of tradables. This link, as we shall see later, is an important ingredient in the "Scandinavian model" of wage determination.

Because domestic SOE money has limited attractiveness to foreign residents it is appropriate to assume that they do not hold it as an asset. At the same time, this money has sufficient liquidity and store-of-value appeal to domestic residents because the role of the nontradable sector in determining the domestic price level is not insignificant so that McKinnon's (1963) requirement for an optimum currency area is satisfied.

The other asset, government bonds, has different characteristics. Merely because it is issued by the government of an SOE does not place it at a disadvantage in the portfolios of world residents. The risk of default is not necessarily higher in an SOE than in large economies and so equality of interest rates, maturity and other features may be sufficient to make an SOE bond a perfect substitute for world bonds. The introduction of exchange-rate risk creates complications, but as long as expected yields, including capital gains or losses arising from changes in the exchange rate, are equalized, domestic and world bonds can still be considered perfect substitutes. However, the argument about price-taker behaviour in the bond market is altered. An SOE is a price taker in world bond markets under fixed exchange rates that are expected to prevail into the indefinite future and the

domestic interest rate is constrained to be equal to the world interest rate. With flexible exchange rates, entailing day-to-day uncertainty about future exchange rates, the domestic interest rate can deviate from the world interest rate to the extent that the expected exchange rate is different from the prevailing exchange rate leading to capital gains or losses to foreigners holding SOE bonds. As a result, an SOE has some control over bond prices in the short run when expected and actual exchange rates do not coincide, but in the long run, by definition, such divergences cannot occur.

2.3 Canada's Economic Structure as an Approximation of an SOE

The structure of a small open economy presented above represents an extreme abstraction, useful for analytical purposes, but difficult to apply to any particular economy. Yet taking such an extreme view in describing the structural characteristics of an economy has one important virtue: it is a beneficial antidote to the typical application of an open economy "Keynesian" model to situations where it is particularly inappropriate. The open-economy version of the "Keynesian" model, despite elaborate trade and balance-of-payments relationships is, for all intents and purposes, a closed-economy model, because prices are essentially determined by domestic factors, with trade in commodities and assets treated as mere appendages to domestic activities in these areas. So "Keynesian" models and SOE models represent extremes at the opposite ends of a scale measuring the

relative importance of external factors in the determination of important domestic macroeconomic variables, most particularly the price level or rate of inflation and national output.

What evidence would we require to "prove" that Canada is an SOE? Essentially what is needed is evidence that the relevant price elasticities facing Canada in markets where it trades internationally are infinite and that these markets are of considerable importance. In markets where Canada is a net supplier (i.e., exportables) we would have to find that the world demand for these commodities is infinitely elastic; in those markets where Canada is a net buyer (i.e., importables) we would have to find that the elasticity of world supply is infinitely large. That this evidence is crucial can be most easily appreciated by remembering that an SOE as a price taker has the same role in the international market place as the perfectly competitive firm has in a specific industry. The atomistic competitor exists if the demand curve facing his output is perfectly horizontal and if the supply curve of factors of production to him is also horizontal.

In terms of testing the applicability of the SOE hypothesis to Canada, or to any other country for that matter, severe difficulties are encountered because estimating the relevant elasticities is usually not an easy matter, but, in addition, there is a problem of deciding whether any particular departure from infinity is significant.

Not surprisingly, other tests of the SOE hypothesis have been suggested and performed but they are often not strictly valid. These hypothesis tests usually take the form of specifying that the Canadian price of a commodity is not significantly different from that in the United States, or the rest of the world as a whole, adjusted only for the exchange rate. For assets, the hypothesis is often framed in terms of equality of interest rates. Whatever the results of these tests, their findings are largely irrelevant to the SOE hypothesis. Equality of prices or interest rates is neither a necessary condition for an SOE nor a sufficient one. Equality of prices is just as much a feature of oligopoly as it is of perfect competition. For example, the application of such invalid tests to the steel industry would lead to the conclusion that this industry conforms to perfect competition instead of the well-documented price-leadership model. Furthermore, the requirement for contemporaneous equality of observed domestic and foreign prices may be too stringent a test for the SOE hypothesis. Because of the existence of contracts, either explicit of implicit, observed prices in an SOE may lag behind changes in world prices or the exchange rate but price-taker behaviour is still maintained if new contracts incorporate the changed circumstances.

As a result, the recent empirical literature on the "law of one price" while interesting from other points of view cannot be said to verify or refute the SOE hypothesis, nor, it should be pointed out, do the authors of these studies typically make such claims.

2.4 The Evidence on Canada as an SOE

Very little work has been done on the test of the SOE hypothesis as it applies to Canada and what little there is seems to provide mixed results.

2.4.1 Commodity Markets

A recent study by Wurzburger (1978) suggests initially that the SOE hypothesis as applied to exportables cannot be rejected. (Importable markets were not tested). However, the facts cited should not be construed as evidence for or against the hypothesis. Wurzburger uses the invalid test of price equality and performs a regression of Canadian export prices on exchange-rate adjusted U.S. prices and domestic prices, with the coefficients required to add to one. (No theoretical support is given for this requirement.) Wurzburger finds that, "My estimated equation validates...the small open economy model." (p. 3) But then he rejects the SOE hypothesis because, contrary to his theory, the quantity of exports is not determined by domestic supply considerations alone. His overall conclusion, best characterized as a weighted average of rejection and acceptance, "Mixed evidence is non-corroborative and the small-open-economy hypothesis should be embraced with caution." (p. 22)

Another recent study by Appelbaum and Kohli (1979) finds that the SOE hypothesis cannot be rejected for the importable market, but it may have to be rejected for exportables. They calculate the necessary elasticities of supply or demand and conclude, "Canadian firms do not have any monopsonistic power with respect to U.S. exports." (p. 9) But, "Canadian exporters have and make use of some monopolistic power vis-à-vis U.S. importers. Canadian exporters perceive a downward sloping demand curve for their products." (p. 10) Of the two studies cited, the findings by Appelbaum and Kohli are much the stronger because of the correct formulation of the hypothesis.

2.4.2 Assets

The evidence on asset market integration between Canada and the rest of the world, most particularly the United States, comes from two sources: (i) the response of international capital flows to interest differentials between Canada and the U.S. for equivalent assets, and (ii) the ability of domestic stabilization policies to change the Canadian interest rate in the face of a constant interest rate in the United States. The first is a partial equilibrium test in that it focuses only on portfolio adjustments while the second is a general equilibrium test, allowing for a variety of international interactions.

If Canada is a price taker in world asset markets then, according to the first test, we should find evidence of infinitely large responses of capital flows to interest differentials so that the domestic interest rate adjusts immediately and fully to the foreign interest rate. Using the second test we would want to determine statistically the inability of domestic policies to change the interest rate, especially under fixed exchange rates. In the open-economy IS-LM framework, the locus for balance-of-payments equilibrium should be horizontal, intersecting the vertical (interest-rate) axis at the "world" interest rate.

As in the case of goods markets, it should be borne in mind that tests of the SOE hypothesis for the asset markets that rely on the synchronized movements of domestic and foreign interest rates are also invalid because it is quite possible for a "large" country to keep interest rates in line with those in the rest of the world to prevent capital flows. The resulting evidence would be inappropriately ascribed to price-taking behaviour.

Three large-scale econometric studies have been chosen to provide us with the evidence on the SOE hypothesis for the asset markets. For the size of capital flows, the RDX2 equation for trade in outstanding bonds predicts that, "an increase of 1 percentage point in the Canadian interest rate would lead to a $57 million inflow of funds during the current quarter." (Helliwell et al., 1971, p. 213) TRACE, on

the other hand, projects a $1.4 billion long-term capital inflow during the first year and $419 million in short-term capital. (Carr et al., 1976, p. 104) Finally, Caves and Reuber (1971) find capital-flow elasticities are in the range of 6 to 10. (p. 91) From this evidence, conclusions about price-taking behaviour are difficult to draw; capital-flow elasticities are large but not infinitely large suggesting that Canadian and U.S. bonds are close but not perfect substitutes.

From the general equilibrium test of the SOE hypothesis the results are also inconclusive. Simulations using RDX2 showed that a $100 million increase in government expenditures financed by the sale of Treasury bills would lead to an increase in the short-term interest rate of only 40 basis points, at the very most. (p. 251) For a much larger stimulus of $500 million increase in government expenditures, TRACE predicts an increase in the long-term interest rate of .085 percentage points at the end of three years while the short-term rate rises by .116 percentage points.

Caves and Reuber provide us with evidence of another sort. They estimate the adjustment in Canadian interest rates if the U.S. rate increases. They report, "We found that up to 90 per cent of policy induced variations in the short-term rate can be eliminated by induced capital flows." (p. 145) Other findings in their study are somewhat less favourable to the hypothesis, but in almost all cases, the adjustment is large.

There is one other dimension of the SOE that requires testing, but for which evidence is unlikely to be available. That dimension, as suggested by Purvis (1976) is time. A country may satisfy every characteristic of an SOE specified so far but still lose its price-taking behaviour over time. Consider the following example. A country can be a price-taker in the world bond market if its proportion of world bonds is "small." However, if it has a continuous government budget deficit, requiring the issuance of new bonds over time, sooner or later, world holdings of these bonds will become sufficiently large so that future additions will only be absorbed into portfolios with higher yields and the country is no longer an SOE in asset markets.

In summing up the evidence on the SOE hypothesis as applied to Canada, we are left with the impression that domestic actions can influence the price of internationally traded goods and assets, but not to a large extent or for very long. Canada is certainly not an SOE in the strict definition of that term, but it comes close enough to warrant treatment as such.

For our purposes it is sufficient to justify the two-sector approach to the goods and services markets of the economy, with one sector being characterized by price-taking behaviour and the other by price independence, within limits. Whether the economy is divided into tradables and non-tradables, as much of the literature on SOE's has done,

or whether, in view of Canada's ability to influence export prices to some extent, it would be more appropriate to divide the economy along different lines is an open question. A number of research strategies is possible. Shinkai (1973) treats importables as the price-taking sector and exportables plus nontradables as the other. Purvis (1978), on the other hand, has only one commodity that is produced at home, part of which is exported, while import goods are not produced at all. In Prachowny (1975) the distinction was made between tradables (i.e., exportables plus importables) and nontradables; I intend to maintain that distinction in this study. While I am aware of its drawbacks, there are also some advantages. From an empirical standpoint, although Appelbaum and Kohli found that the export industries as a whole had some monopoly power in international markets, there are a number of individual industries for which this conclusion is unlikely to hold (e.g., wheat). Furthermore, since internal transportation costs can be quite large in a country of the size of Canada, an industry could both export and import, making it difficult to characterize its price behaviour and suggesting that its treatment as a tradable industry is the most obvious solution. Finally, from a theoretical point of view, treating exportables and importables symmetrically has the advantage of showing unambiguously the effects of exchange-rate changes on

the relative price of the two sectors. If, alternatively, exportables and nontradables are lumped together as a composite good, exchange-rate changes are difficult to evaluate.

The lack of conclusive evidence on asset market behaviour, on the other hand, while bothersome, is not decisive for this study. While Mundell (1963, 1964) proved that perfect capital mobility generated the strong results of monetary policy impotence under fixed exchange rates and fiscal policy ineffectiveness as a stabilization instrument under flexible rates, this study will be less concerned with the effects of individual policy instruments under different exchange rate regimes and more concerned with general policy effects on macroeconomic performance of an SOE, with and without wage indexation. As a result, the specification of the asset markets in subsequent sections of this study will be given less emphasis than the specification of the goods and labour markets. Nevertheless, from time to time, it will be necessary to make a clear distinction between fixed and flexible exchange rates because of different implications for domestic prices. For clarity of exposition, but at some expense to the relevance for Canadian conditions, the strong assumption about perfect capital mobility will be incorporated into the asset markets at that stage of the analysis.

3. THE LABOUR MARKET AND MACROECONOMIC EQUILIBRIUM

To set the stage for a discussion of the impact that wage indexation might have on the macroeconomic performance of an SOE, it is necessary to introduce the relevant concepts and analytical tools. The main feature of this framework involves nothing more complicated than supply and demand curves derived for the aggregate economy. It is convenient to describe this framework first for a one-sector closed economy and later to amend it for an open two-sector economy.

3.1 The One-Sector Economy

In a one-sector economy, producing one homogeneous commodity or a variety of goods and services, but with relative prices held constant, the price-quantity relationships provide us with two important macroeconomic variables: total output or income and the price level.

As shown, for example, in Branson (1979, Ch. 7), the aggregate supply and demand curves are derived from a set of equilibrium conditions. The markets for which these equilibrium conditions are specified can be enumerated: (i) the goods and services market, referred to as the IS curve, (ii) the money market, providing the LM curve, and (iii) the labour market. In addition the production function for the aggregate economy is used to link inputs and total output.

The IS and LM equations together give rise to the aggregate demand curve and the other two relations generate the aggregate supply curve, as shown in Figure 3.1. Their

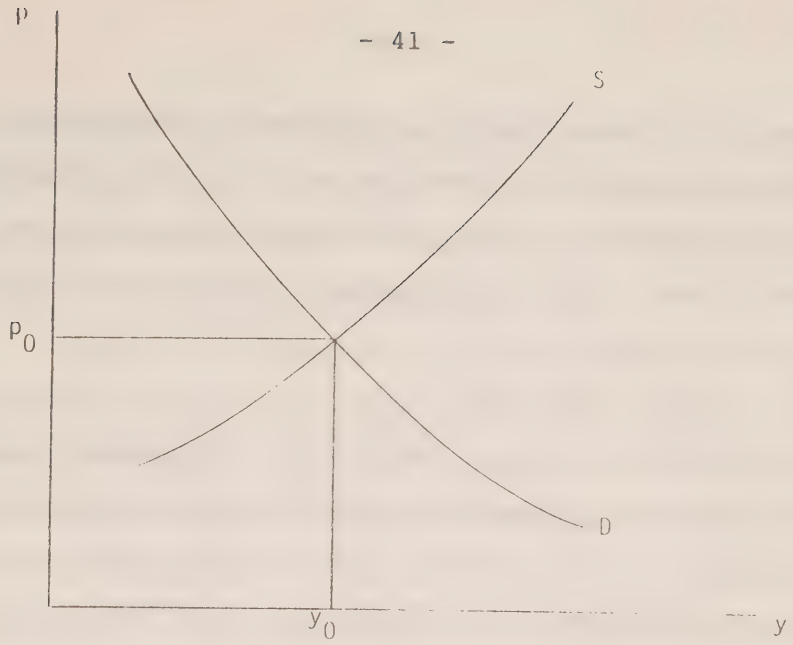

Figure 3.1

Aggregate Demand and Supply Curves

intersection simultaneously determines the equilibrium price level (p_0) and total output (y_0). For later purposes it is necessary to explore the slope and position of these two curves.

The demand curve has a negative slope since a drop in the price level with output held constant creates excess supply of money and therefore requires an increase in income to re-establish equilibrium in the money market. Any exogenous increase in an expenditure category (e.g., government expenditures or autonomous consumption) will shift the aggregate demand curve up and to the right as will an increase in the real money supply because of its effect on lowering interest rates which stimulates investment expenditures. An

increase in the money supply also increases consumption expenditures through its effect on wealth. This "wealth effect" also applies to other categories of assets such as government bonds. Thus the aggregate demand curve can be written as

$$e = D(G, M/p, B/p) \qquad (3.1)$$

where e refers to aggregate demand, G is government expenditures or any other independent demand for goods and services, M is the stock of nominal money and p is the price level, so that M/p can be referred to as the real money stock and B/p is the real stock of government bonds.

The slope of the aggregate supply curve depends largely on what assumption one is prepared to make about the existence of money illusion in the labour market. Starting with the production function

$$y = y(N,K) \qquad (3.2)$$

where y represents total output, N is the labour input and K represents the input of capital services, it is customary to treat N as the variable factor and K as the fixed factor of production in short-run models. The level of employment is, in turn, determined by supply and demand conditions in the labour market. On the demand side, the real wage is determined by the marginal product of labour, so that

$$y_N' = w/p = f(N) \qquad f' = y_N'' < 0 \qquad (3.3)$$

where w is the nominal wage per unit of labour so that w/p is the real wage which declines with the level of employment because the marginal product of labour falls as labour input increases, with capital held constant.

Workers are assumed to derive utility from the consumption of goods and leisure and the real wage is the appropriate variable in the work-leisure decision, with a higher real wage leading to a larger supply of labour and a reduction in leisure. But the real wage facing the suppliers of labour is treated differently from that on the demand side, mainly because of asymmetrical availability of information. Employers know the price of their output and the price of labour at every moment in time. But suppliers of labour face a more uncertain set of circumstances. As Branson (1979, p. 103) explains:

> A worker must deflate a known wage income by a price index, such as the CPI, that covers a wide range of products to arrive at an estimate of the real wage. Thus his or her information concerning the price level...is not as good as that of employers and an explicit assumption linking workers' estimates or expectations of the price level to the actual price level is needed.

In addition, even if such estimates can be made, workers may not be able to act on them if labour contracts specify nominal wages to be paid over the life of the contract, without adjustments for unexpected changes in the price level. (As we shall see later, the introduction

of wage indexation reduces or eliminates this source of real-wage uncertainty. In essence, indexation shifts the burden of asymmetrical information from the worker to the employer.) We can incorporate this complex decision-making process into the following supply-of-labour relationship:

$$w/\bar{p} = g(N) \qquad g' > 0 \tag{3.4}$$

where $\bar{p}$ is the expected price level. Since $\bar{p}$ is an unobservable variable we can only hypothesize as to how it is formulated, but in general, price expectations are presumed to be based on actual prices, now and in the past. Thus the nominal wage is determined by

$$w = w(\bar{p}\ (p)) = w(p) \qquad 0 \leq w' \leq 1 \tag{3.5}$$

The larger is money illusion on the part of workers, the smaller is the value of the parameter w'. If, on the other hand, expected prices are forecast with precision and if workers are able to adjust immediately and fully to these expectations then money illusion is absent and w' = 1. This is often called the "classical model."

Equations (3.3) and (3.4) contain three variables, w/p, $w/\bar{p}$ and N, but (3.5) links p and $\bar{p}$. Substituting for N in (3.2) allows us to derive the aggregate supply curve as a relationship between y and p.

$$y = S(w(p)/p) \qquad S' < 0 \tag{3.6}$$

In general, the supply curve has a positive slope, as shown in Figure 3.1. In this case, where expected prices are presumed to lag behind actual prices or expectations cannot be acted on without some lags, an increase in prices leads to only a partial immediate adjustment in nominal wages resulting in a reduction in the real wage, higher employment and increased output. In the classical model, however output is divorced from the price level because any increase in prices is matched immediately and fully by an increase in the nominal wage leaving the real wage, employment and output unaltered.

It remains to show that in the aggregate demand-supply diagram, an upward shift in the demand curve generated by expansionary monetary or fiscal policies [M/p or G are increased in equation (3.1), subject to the government budget constraint of $G = \dot{M}/p + \dot{B}/p$] will increase both output and the price level, the proportion depending on the slope of the supply curve. This allows us to derive an important conclusion: shifts in the demand curve determine the change in nominal income (py) but the supply curve determines the extent to which this is translated into price changes.

Before concluding this section, one important characteristic of the aggregate supply-demand analysis needs to be stressed. These relationships link price <u>levels</u> and output. <u>Inflation</u>, which must be defined as a continuing price change over time, is not treated in this analysis. The analytical development of price-level dynamics is postponed

until Section 6. Nevertheless, much insight can be gained about the operation of wage indexation and its consequences for the economy even when we consider a more simple environment of once-and-for-all price changes.

3.2 The Two-Sector Model and Labour Market Equilibrium

Allowing for two composite goods, the relative price of which is endogenously determined, introduces complications and eliminates some of the simplicity and rigour of the one-sector model, but a proper understanding of the structure of an SOE requires this modification even at the cost of increased complexity.

The crux of the problem is that, in a two-sector model, relative price changes create ambiguity about the effects of exogenous changes for both the aggregate supply and demand relationships. Let us explore the supply side first. To define aggregate output involves an index number problem. Using tradables as the numeraire, total output is equal to

$$y = Q_t + zQ_n \qquad (3.7)$$

where Q_t and Q_n are outputs of tradables and nontradables, respectively, and z is the relative price of nontradables in terms of tradables ($z = p_n/p_t$).

In each sector, the determination of output is similar to that of the one-sector model of equation (3.6), so that

$$Q_t = S_t(w(p)/p_t) \qquad S_t' < 0 \qquad (3.8)$$

$$Q_n = S_n(w(p)/zp_t) \qquad S_n' < 0 \qquad (3.9)$$

One difference that can be noted however, is that the real wage for each sector involves deflating the common nominal wage by the price of the output of each sector. The nominal wage, assumed to be the same in both industries because of labour mobility even in the short run, again depends on expectations of the price level which in turn is presumed to be determined by the actual price level, in this case composed of a weighted average of the prices of tradables and non-tradables. As a result, the real wage from the point of view of the employers in the two industries (w/p_t and w/p_n) can differ from each other and in turn can differ from the real wage as perceived by workers (w/p).

The price level is determined by an index number.

$$p = kp_t + (1-k)p_n = p_t + (1-k)z \qquad (3.10)$$

where k is the fixed weight given to tradables in the price index ($k=p_tQ_t/py$). The second part of (3.10) allows us to focus on absolute price changes with relative prices held constant ($dz = 0$) as well as on relative price changes themselves. Choosing tradables as the numeraire has the advantage of identifying p_t with the price level. Thus if the exchange rate and the world price of tradables are constant the domestic price level can change only to the extent of a change in z. Substituting (3.8) and (3.9) into (3.7) allows us to write the aggregate supply function as

$$y = S(w(p)/p,z) \quad S'_{w/p} < 0, \; S'_z = ? \qquad (3.11)$$

or more compactly as

$$y = S(p_t, z) \quad S'_{p_t} > 0, \quad S'_z = ? \qquad (3.11')$$

(In Appendix I, the derivation of these equations is given in more detail.)

As can readily be seen, the total level of output in an SOE producing both tradables and nontradables depends on both the absolute price of tradables and the relative price of nontradables. An increase in p_t with z held constant increases the price of both outputs in the same proportion. This leads to increased output in both sectors, the extent of the increase depending only on the adjustment of the nominal wage to the increase in the price level. Thus the slope of the aggregate supply curve hinges again on the degree of money illusion on the part of workers or their inability to adjust nominal wages to anticipated price changes. An increase in z also involves an increase in the price level, although in a smaller proportion, but its effects as a relative price change creates ambiguity about the resulting level of total output. With a rise in z, the profitability of nontradables is stimulated at the expense of tradables. Thus the former sector will expand and the latter will contract. Labour, the only variable factor of production, will move out of tradable industries as wages and employment opportunities have a tendency to deteriorate and move to nontradable industries. (Before and after the change all labour is fully employed.) Thus the "absolute-price" effect of an increase in z on output

is positive, but the "relative-price" effect is ambiguous. Whether or not we end up with only a compositional change in output or a change in total output as well from the "relative-price" effect depends on differences in labour intensities and in elasticities of factor substitution. (See Appendix I for the derivation of this result.) If, for instance, non-tradables are labour intensive compared to tradables, then every worker who shifted to that sector will produce a larger output than is forfeited in the tradable sector. Total output is increased and the aggregate supply curve shifts down and to the right as in Figure 3.2 from S_0 to S_1. If, on the contrary, tradables are labour intensive and the "relative-price" effects overpower the "absolute-price" effects the supply curve can shift to the left to S_2. Finally, if non-tradables have a higher elasticity of factor substitution, greater total output is possible with a given level of total employment and the aggregate supply curve will shift to the right. One must therefore conclude that, in the absence of information about these parameters, an increase in z has ambiguous effects on total output.

The derivation of the aggregate demand curve is also somewhat complicated but with the aid of a few simplifying assumptions, a useful relationship can be established. Total demand for domestic goods is generated by domestic residents and foreigners. In the nontradable sector, domestic private demand and government expenditures must exhaust the total

output since, by definition, nontradables are neither exported nor imported. In the tradable sector, however, net foreign demand must be added to domestic private demand and government purchases to equal output of tradables. We can therefore write the following identity:

$$e = A_t + T + G_t + z(A_n + G_n) \qquad (3.12)$$

where e is aggregate demand measured in units of tradables, A_t and A_n are private domestic demand for tradables and nontradables, respectively, G_t and G_n are government purchases of tradables and nontradables and T is the trade balance. (Since government expenditures on tradables play no stabilization role, it will henceforth be assumed that $G_t = 0$).

Domestic private demand for each of the two types of goods is assumed to depend on the relative price and nominal income, the latter being determined by the IS-LM relationship can be eliminated by the substitution of the three exogenous variables in that relationship, the real money supply, the real bond supply and government expenditures on nontradables. An SOE can buy or sell as much as it wants in the tradable market, given international prices so that the size of the trade balance is determined essentially by domestic variables. Since T represents the difference between domestic output and domestic expenditures on domestic goods, it is equal to saving

or wealth accumulation over time. This process depends on existing wealth in the form of money and government bonds with $T = -zG_n$ or $y = e$ when actual and desired wealth are equal. This information can be summarized as follows:

$$e = A_t(z, M/p, B/p, G_n) + T((M+B)/p) + z(A_n(z, M/p, B/p, G_n) + G_n) \qquad (3.13)$$

The sign of each derivative is shown over each variable. Equation (3.13) can be written more compactly as

$$e = D(G_n, M/p(p_t,z), B/p(p_t,z)) \qquad (3.13')$$

The slope of the aggregate demand curve (with p_t on the vertical axis) is negative because an increase in the price level (with z held constant) reduces the real value of assets and this requires a reduction in expenditures and income to re-establish equilibrium. An increase in M/p, B/p or G_n shifts the aggregate demand curve up and to the right because they all represent an increase in the demand for tradables, nontradables or both. An increase in z has several effects. First of all it causes a shift in expenditures from non-tradables to tradables, but it can safely be assumed that this effect on <u>total</u> private demand is small enough to ignore in most circumstances. In addition a higher z creates an increase in the price level, but in smaller proportion, which again reduces the real value of assets and requires a reduction in expenditures. Hence an increase in z causes the aggregate demand curve to shift down and to the left.

It should be noted that in equation (3.13') the determinants of e are not all independent of each other. For instance, an increase in G_n will lead to an increase in z because of excess demand in the market for nontradables. Moreover, policy changes involve simultaneous changes in more than one policy variable. The case of money-financed government expenditures requires that both G_n and M would increase, while bond-financed expenditures lead to G_n and B moving together.

In a closed economy, changes in either the money supply or government expenditures would be considered to be equally available stabilization policy instruments for the purpose of changing the level of output or income. However, in an SOE, as Mundell (1963, 1964) has proven, some important restrictions apply. He showed that, because of perfect capital mobility, open market operations cannot change the domestic money supply under fixed exchange rates, making monetary policy ineffective while under flexible exchange rates, fiscal policy in the form of increased government expenditures financed by the sale of bonds to the public cannot change output, because the fixed money supply and interest rate are the constraints to this variable. While his conclusion about fiscal policy holds strictly only in a one sector SOE, it is important to treat the money supply as an endogenous variable under fixed exchange rates.

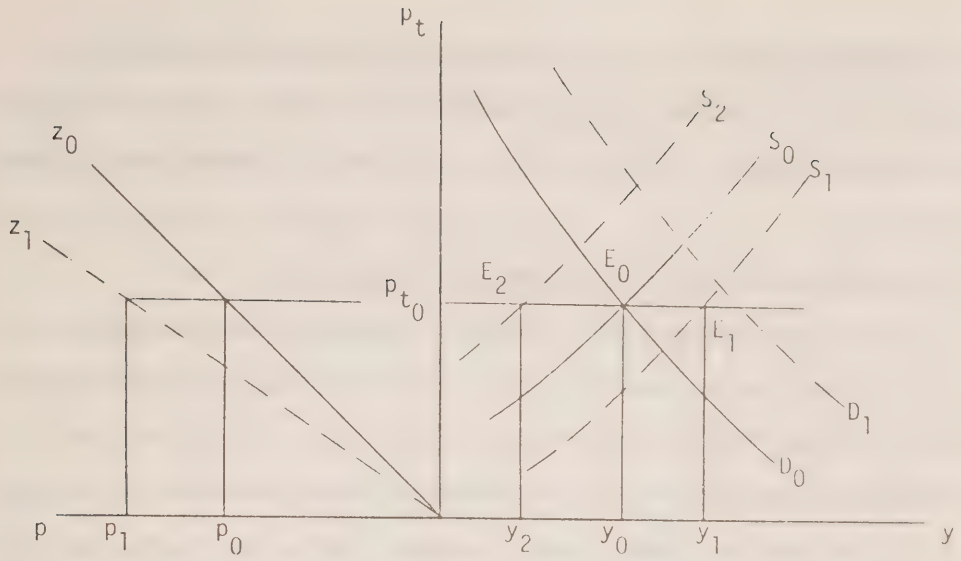

Figure 3.2

Aggregate Demand and Supply Curves in an SOE Under Fixed Exchange Rates

The right-hand section of Figure 3.2 depicts the aggregate supply and demand relationships discussed above. This diagram differs somewhat from that of the closed economy (Figure 3.1) in that p_t is on the vertical axis. To show the relationship between p and p_t we require the left-hand section of Figure 3.2 which shows a positively-sloped line for a given z. An increase in z increases p for a given p_t and thus makes the slope flatter.

We can now analyse the macroeconomic performance of an SOE when it is subjected to an exogenous shock. Typically the specification of policy changes is more difficult in a

two-sector SOE so that we will content ourselves with a complete discussion of a change in government expenditures on nontradables. Both fixed and flexible exchange rates are considered.

3.3 Fiscal Policy Under Fixed Exchange Rates

An increase in government demand for nontradables will, according to equation (3.13') shift the aggregate demand curve to the right, such as D_1 in Figure 3.2. But a new equilibrium cannot be established at the intersection of D_1 and S_0 because p_t must remain constant when the exchange rate is fixed and the SOE has no power to infuence the world price of tradables. Hence either the aggregate supply curve or the aggregate demand curve or both will have to make further adjustments to reach a new equilibrium. The increased government expenditures will lead to an increase in the relative price of nontradables which reduces aggregate demand and changes both the composition and level of total output. In the left side of Figure 3.2 the increase in z to z_1 leads to an increase in the price level to p_1.

If nontradables are labour intensive or if the elasticity of factor substitution is higher in this industry compared to tradables, the S curve will shift to the right, establishing a new equilibrium at E_1 with increased output at y_1. (The aggregate demand curve will also have to shift, but its role in the process of determining equilibrium is secondary, because under fixed exchange rates, the horizontal line at

p_{t_0} must be maintained.) Alternatively, if tradables are labour intensive or if they have a higher elasticity of factor substitution, the S curve can shift to the left resulting in a decline in total output at y_2.

It can now be seen that a policy which is clearly meant to be expansionary may turn out to be contractionary if information about factor intensities or elasticities of factor substitution is not available. The crucial importance of this information becomes evident when one considers the following, rather unintuitive policy advice: if tradables are labour intensive a reduction in government expenditures can increase output and reduce the price level. This result is more than an academic curiosum, because in an SOE, not only is the appropriate size of stabilization policy in doubt but so is the appropriate direction unless we can eliminate our ignorance about factor intensities and elasticities of factor substitution in the two sectors. While, to my knowledge, not even fragmentary evidence is available for Canada, Helpman's (1976) estimates for Sweden are somewhat disturbing. He found that nontradables were labour intensive in 1960, but by 1967 they had become capital intensive. The implication of this finding is that determining the relative factor intensities once and for all is not sufficient to make stabilization policies immune from the possibility of perverse results. The lack of statistical research in this area can only be lamented.

3.4 Fiscal Policy Under Flexible Exchange Rates

When exchange rates are flexible, the domestic price of tradables is no longer fixed, and equilibrium can lead to a higher or lower exchange rate, resulting in p_t rising or falling. However, another constraint is now binding. Under fixed exchange rates the money supply was endogenously determined by the level of nominal income, but with flexible rates, the central bank can control the monetary aggregates. In this experiment, they are assumed to maintain the existing money supply so that nominal income must remain unchanged. This can be accomplished at a higher level of output and a lower price level or at reduced output and an increased price level. This requirement is depicted in Figure 3.3 by a rectangular hyperbola shown as M. (Note that p is on the vertical axis in this diagram). The position of this curve is determined by the nominal money supply, an increase shifting the curve to the right and up.

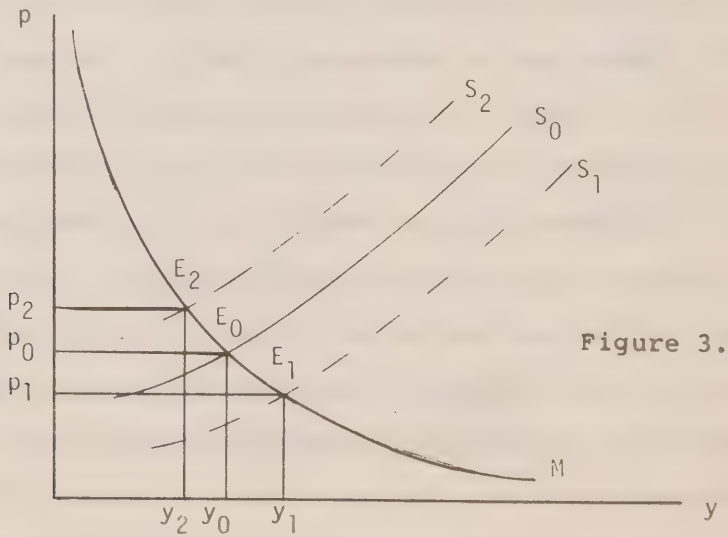

Figure 3.3

An SOE with Flexible Exchange Rates

The aggregate supply curve now has a slightly different interpretation. It is still positively sloped for wages adjusting only partially to price increases, but an increase in z only has "relative-price" effects in shifting the curve. Thus S is drawn for a given z. The initial price level and output are given by p_0 and y_0 from the intersection of the M and S_0 curves at E_0. An increase in G_n leaves the M curve unchanged, but because of its effect on increasing z, the S shifts to the right or left depending on factor intensities and elasticities of factor substitution. Thus, as in the case of fixed rates, an expansionary policy could lead to contractionary results with a higher price level, p_2 and lower total output at y_2.

3.5 General Conclusions about Stabilization Policies in an SOE

In a closed economy the greatest uncertainty faced by policy makers is the extent to which expansionary policies will lead to output changes and to what extent they will lead to inflationary pressures. The current wisdom appears to be that, in the short run, because wages lag behind prices, output effects can dominate, but after some delayed adjustments, it is ultimately the price level that absorbs these policy-induced effects. Hence, the focus of attention of the "new macroeconomics" is on the slope of the aggregate supply curve.

In a two-sector SOE, stabilization-policy impotence in the longer run is likely to be of secondary importance. Of primary concern is the possibility of perverse effects in the short run. Even in an inflationary environment where all prices are rising, relative price changes are of particular importance in an SOE. Unless these relative price effects can be anticipated, conventional "stabilization policies" could destabilize the economy.

4. MACROECONOMIC PERFORMANCE WITH AND WITHOUT WAGE INDEXATION

The most potent argument in favour of wage indexation is that it protects the worker's real wage against unexpected increases in prices. Therefore, from the worker's point of view indexation replaces the need for accurate predictions or reduces the frequency of labour negotiations. The present section of the study is concerned with a comparison of the macroeconomic performance of an SOE without wage indexation, where nominal wages remain constant in the face of unpredicted changes in prices, to an SOE where complete indexation prevails. The major effect of indexation is to make the aggregate supply curve vertical compared to its positive slope without indexation.

Wage indexation reveals its advantages only in a context of unexpected events and thus our previous analysis must be amended to take into account stochastic disturbances -- random events that simply cannot be predicted. The way ahead has been prepared by the earlier introduction of price expectations on the part of workers in determining the real wage and the recognition that indexation can overcome the errors made in expectations. However, too narrow a view can be taken if only unexpected <u>monetary</u> events such as price shocks are allowed to enter the analysis. If, in addition, the economy is subjected to <u>real</u> shocks, then indexation can

be harmful in requiring adjustments in output and employment that are larger than would be necessary in an economy without indexation. This proposition, put forward by Gray (1976), emphasizes that wage indexation has advantages for stabilization purposes in only a limited set of circumstances. She concludes, "Indexing cannot, in general, completely neutralize monetary variability; it appears therefore to be an inadequate substitute for intelligent behavior on the part of the monetary economy." (p. 233)

4.1 Indexation in a One-Sector Economy

Having introduced the aggregate demand-supply framework in the previous section, it is relatively straightforward to introduce Gray's analysis into that framework, setting the stage for a discussion of indexation in a two-sector SOE. The essential feature of Gray's contribution is that both monetary and real shocks are randomly generated. By the very nature of these shocks, it is impossible to distinguish between them at the time that they occur. However, conceptually, we recognize that monetary shocks give rise to variability in the location of the aggregate demand curve [as seen from equation (3.1)] and real shocks introduce uncertainty about the location of the aggregate supply curve [as seen from the derivation of equation (3.6)]. It is therefore more descriptive in this context to refer to demand shocks and supply shocks. The purpose of the analysis is to compare price and output effects

after each of these shocks with and without indexation. These shocks, being unexpected, are presumably undesirable and the system that better protects the existing level of output is to be preferred.

Let us consider, first of all, an unanticipated increase in the money supply to represent a demand shock. Figure 4.1 shows the price and output effects of such an event. Panel (a) with the positively sloped aggregate supply curve depicts an economy without indexation. Panel (b) has complete indexation resulting in a vertical supply curve,

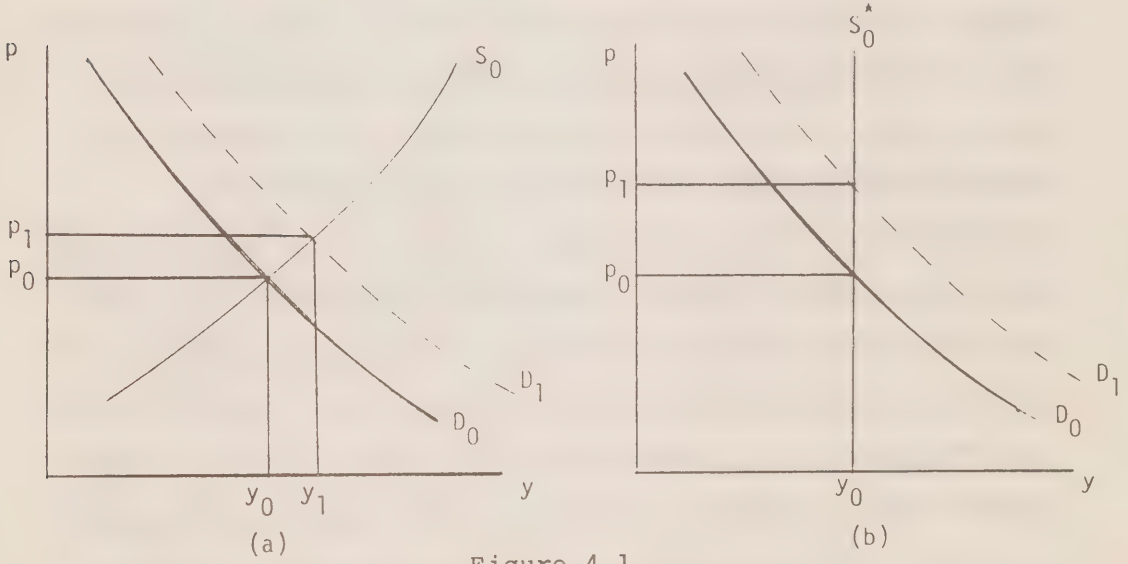

Figure 4.1

Demand Shock and its Effect on Prices and Output

denoted by (*), because the real wage remains constant and output is insensitive to price changes. (Appendix II derives the following results algebraically.)

In both cases the aggregate demand curve shifts up and to the right. Without indexation both output and the price level increase, but with indexation prices and the nominal wage rate rise in the same proportion leaving output unaffected. Thus indexation has insulated the real economy from unexpected monetary shocks.

Consider next a supply shock such as an unexpected decline in the marginal product of labour. This implies that the real wage should decline to restore equilibrium. Figure 4.2 depicts this situation. The supply curve without indexation (S) and with indexation (S*) are shown in the same diagram for easier comparison. In both cases, the supply curve shifts to the left by equal horizontal distances, E_0X, because at any price level, with or without indexation, a given reduction in output is associated with the lower productivity of labour. Without indexation this shock leads to a decline in output and an increase in prices (see point E_1); with indexation the decline in output and the increase in the price level are both larger (see point E_1^*). Given the nature of the shock, indexation is unambiguously undesirable because it prevents the reduction in the real wage that is necessary to allow the economy to reach a new equilibrium with the minimum decline in output (to y_1 instead of y_1^*).

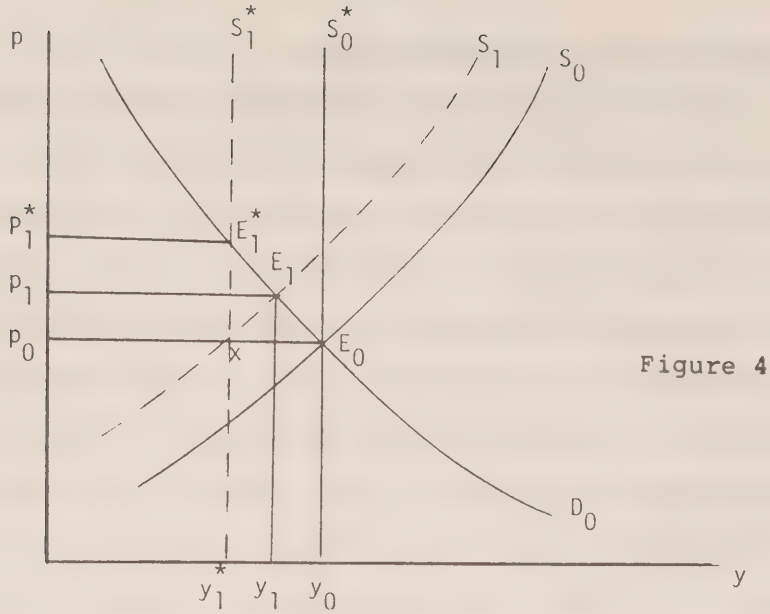

Figure 4.2

Supply Shock and its Effect on Prices and Output

An increase in labour productivity would shift S and S* to the right (not shown in Fig. 4.2). Output increases and price falls more with indexation than without. Since it leads to a larger displacement, indexation is again undesirable. Nevertheless it could be argued that an increase in output and a fall in price could never be considered undesirable merely because of the unexpected nature of the event. This creates an asymmetry about the virtues of indexation based on the direction of the shock. However, indexation may not operate for decreases in prices, making the comparison of outcomes irrelevant.

4.2 Indexation in a Two-Sector SOE

As we shall see, the advantages of indexation in this environment are more ambiguous than in the more simple one-sector model. If it were possible to identify demand and supply shocks as before, the results would continue to hold, so that indexation is desirable in the face of nominal shocks and undesirable in the face of real shocks. But almost any random shock in an SOE is likely to alter the relative price of nontradables and this will cause both the demand and supply curves to adjust. So the most interesting disturbance to investigate in an SOE is an unanticipated increase in this relative price. The effects will differ not only between indexation and its absence, but also between fixed and flexible exchange rates.

4.2.1 Fixed Exchange Rates

In this situation p_t must remain constant; therefore it is possible to analyse the effects on total output and the price level using only the aggregate supply function of equation (3.11) and the price-index equation (3.10). An increase in the relative price z will cause the aggregate supply curve to shift to the right or to the left. If it shifts to the right (nontradables are labour intensive or have the higher elasticity of factor substitution), then the shift will be smaller with indexation than without. Thus in Figure 4.3, the horizontal distance between S_1 and S_0 is larger than between S_1^* and S_0^*. (Appendix II proves this proposition.) The

relative-price effect of an increase in z causes tradable production to decline and nontradable output to increase with total output rising or falling depending on factor intensities or elasticities of substitution. This occurs irrespective of indexation. But an increase in z also has an impact on the price level. With indexation, wages rise to offset fully the increase in the price level leaving y undisturbed on this account, although the proportional increase in w is less than

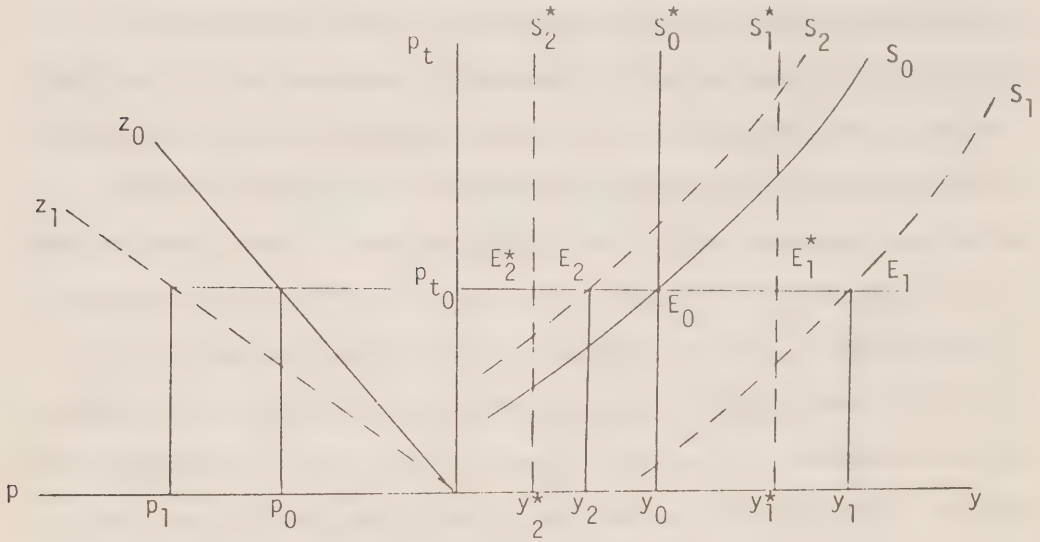

Figure 4.3

Relative Price Shock and its Effect on Prices and Output Under Fixed Exchange Rates

the proportional increase in z because p rises less than proportionately. This leaves the real wage unchanged, compared to the decline in the real wage that would occur without indexation, resulting in higher output from that

source. Whether indexation exists or not, the price level rises to the same extent. So indexation leads to p_1 and y_1^* in Figure 4.3; without indexation we arrive at p_1 and y_1. Since indexation leads to a smaller displacement of total output, it can be viewed as being beneficial.

However, it is also possible that tradables are labour intensive or have the higher elasticity of factor substitution, in which case the relative price effect of an increase in z shifts the supply curve to the left. In Figure 4.3, S_2^* pertains to complete indexation and S_2 to the situation of nonindexation. Without indexation, the increase in z leads to a lower real wage and an increase in total output so that the horizontal displacement to the left is less for S_2 than for S_2^*. In this instance, the decline in output is less without indexation (y_2) compared to indexation (y_2^*).

The general conclusion derived from this discussion can be stated as follows: indexation insulates to some extent the real variables in an SOE from unpredictable increases in relative prices if nontradables are labour intensive or have the higher elasticity of substitution; the opposite holds true for unpredictable decreases in z. This ambivalence about the virtues of indexation rests on the assumptions that indexing formulae are symmetric for increases and decreases in the price level and that both positive and negative deviations

from the original level of output are equally undesirable. However, if indexation operates only for increases in prices and if higher output has greater utility than lower output, then indexation should be favoured.

4.2.2 Flexible Exchange Rates

For this case we rely on the constraint that the money supply, exogenously determined, requires normal income to remain constant when z increases. Thus in Figure 4.4, with p on the vertical axis, we draw a rectangular hyperbola (M). This is not the aggregate demand curve but is derived from the demand side of the economy. On the supply side, an increase in z only has the "relative-price" effect because its "absolute-price" effect has been incorporated in the slope of the relationship.

If nontradables are labour intensive or have the higher elasticity of substitution, the supply curve shifts to the right when z increases, to S_1 without indexation and to S_1^* with indexation, with equal horizontal displacement because the absolute price effect if taken into account in the slope of the S curve. The resulting level of output is larger (y_1^*) with indexation than without (y_1). At the same time the decrease in the price level is also larger for indexation (p_1^*) than without p_1). If the aggregate supply curve shifts to the left we obtain S_2 for the case of nonindexation and S_2^* for indexation. The decline in output and the increase in the price level are larger for complete indexation (y_2^* and p_2^*)

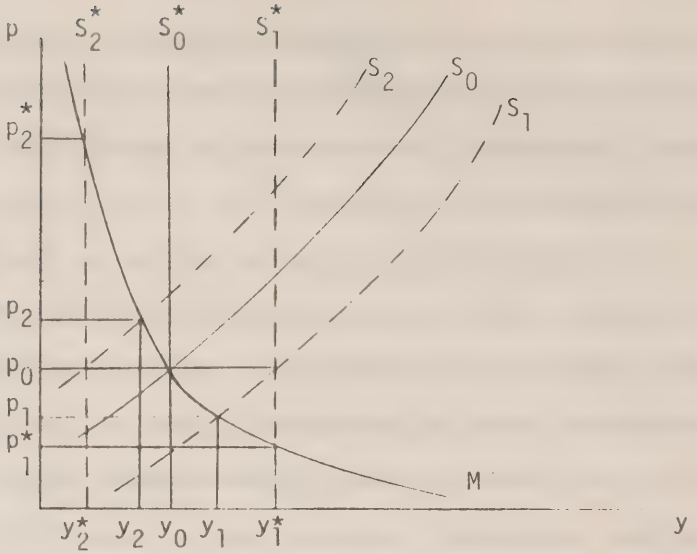

Figure 4.4

Relative Price Shock and its Effects on Prices and Output Under Flexible Exchange Rates

than for nonindexation (y_2 and p_2). Thus, with flexible exchange rates, no matter in which direction the supply curve shifts, indexation leads to greater volatility of both output and prices. This holds true for both unexpected increases and decreases in z and therefore indexation is harmful to the macroeconomic performance of an SOE under all assumptions. The general reason for this is not difficult to find. Flexible exchange rates eliminate the rigidity of the price of tradables allowing the SOE to absorb random shocks in a more flexible way compared to a regime of fixed exchange rates.

However, indexation reintroduces a rigidity into the system, preventing adjustments in the real wage when they become necessary to mitigate the real effects of unanticipated events.

4.3 General Conclusions about Indexation in an SOE

At this stage we can summarize the influence of indexation under various circumstances from the point of view of minimizing output fluctuations when unexpected shocks are introduced: (i) indexation is beneficial when unexpected changes in the price level dominate other disturbances; (ii) indexation is harmful if real shocks dominate because it prevents adjustments in the real wage; (iii) indexation has ambiguous effects if unanticipated changes in relative prices occur under fixed exchange rates; (iv) indexation is harmful when relative price shocks dominate under flexible exchange rates.

5. THE PRIVATE INCENTIVES FOR WAGE INDEXATION

Since wage indexation is subject to the bargaining process, both labour unions and management must be able to see its advantages before giving voluntary consent to its adoption. In Canada, at the present time, no legal coercion can be applied by either side to adopt indexation nor to prevent its adoption. As a basis of comparison, in some countries, such as Germany and France, indexation is prohibited by legislation, even if both parties find it advantageous, while in some other countries, such as Israel, cost-of-living allowances are mandatory. [See Braun (1976), p. 238, for more details.]

One has the superficial impression that some sort of indexation is often included in initial union proposals while management often takes a stand against cost-of-living allowances. But in those cases in which the final contract does incorporate indexation, it must be that management can envisage some benefit. It is therefore of great interest to explore the conditions under which both labour unions and management have an incentive to adopt indexation and those conditions under which conflict occurs. The general incentive for either side to adopt wage indexation is the desire to avoid risk in the face of uncertain events. But only when

both labour and management face the same uncertainty does the mutual advantage of indexation become evident. When the two sides face different random shocks, the incentives will be stronger for one side than the other.

In this section only indexation in the unionized sector is analysed, consistent with the assumption made in Section 1.5. However, it is possible that informal indexation in the nonunionized sector may have the same pattern of incentives as in the bargaining process over a contract between unions and management. This would be especially relevant if labour is very mobile between unionized and nonunionized labour markets, resulting in virtual equality of base wage rates and other benefits, including COLA payments. Nevertheless, as pointed out previously, such COLA payments in the unorganized sector are not typically enforceable in law so that their consideration would require a more complicated analysis of the incentives for compliance with implicit contracts.

Without indexation, bargaining produces a contract in which the nominal wage rate is determined, in addition to fringe benefits, working conditions and other matters, all of which are assumed to be invariant with the extent of indexation. In this environment uncertainty exists for both sides concerning a number of variables. Of special interest to us is the uncertainty about the overall price index and the price of the product that the particular firm sells.

The effect of these uncertainties on the incentives for wage indexation can be analysed in the context of risk-averse behaviour. Both labour and management derive utility from having the "right" real wage. But even though nominal wages are fully determined by the contract, real wages remain uncertain. Moreover the real wage to workers differs from the real wage for firms. The real wage relevant to the suppliers of labour services is the nominal wage divided by a price index composed of a basket of goods so as to measure the purchasing power of wage income. On the other hand, the real wage as viewed by the firm is the nominal wage divided by the price of the output of the firm because this measures the productivity of the workers. What is the effect of this uncertainty about the "right" real wage? Although both workers and management can form expectations about future events, uncertainty implies that there is some probability of error. Some errors in forecasting lead to unexpected benefits such as in the case where the actual increase in the price level is less than that expected leading to a higher real wage, but the existence of risk aversion dictates that all errors are undesirable. Because of these uncertainties, both workers and management maximize <u>expected</u> utility. For labour we can summarize the idea of expected utility in the following form:

the expected utility of the real wage	=	the utility of the expected real wage	- the disutility of an error in expectations about the price level

The greater risk aversion, the greater is the disutility of making an error and the larger is the last term in the above expression. The adoption of indexation reduces the last term to zero. Thus, indexation leads to a higher level of economic welfare for workers for any given nominal wage bargain, or put another way, with indexation labour would be prepared to take a lower nominal wage without a loss of welfare. (Appendix III provides a mathematical derivation of these results.)

For firms, expected utility is derived from profits. Without wage indexation, the uncertainty faced by firms relates to the price of the product they sell. With wage indexation, firms also face uncertainty about the wage that they will have to pay, which in turn derives from the uncertainty about the price level. Expected utility for firms is therefore expressed as:

the expected utility of profits	=	the utility of expected profits	- the disutility of an error in predicting output or input prices

Wage indexation has a different effect on firms than on workers. While indexation clearly eliminates the only source of uncertainty for workers, for firms the outcome is somewhat more complicated. In the first place, an additional variable is now subject to prediction error. Before indexation, the wage was set equal to the expected price level, but now it is set to whatever the price level turns out to be, so that both the commodity price and the price level are

uncertain factors which create disutility for firms who are risk-averse. But if there exists only "pure" inflation without changes in any relative price, the price of the commodity produced by any individual firm and the price level move in perfect harmony. This fact, if known, is of benefit to the firm since its revenues and labour costs are subject to the same uncertainty, reducing the magnitude of the last term in the expected utility formula. Hence firms would be willing to offer an indexed wage of equal size to an unindexed wage and still increase their welfare. As a result we can derive a fairly strong conclusion: if the only uncertainty that exists concerns the price level, both workers and firms have an incentive to adopt wage indexation because of its ability to reduce risk and therefore increase expected utility for both sides of the bargain.

Nevertheless, this conclusion does not necessarily hold once the possibility of other uncertainties is admitted. For instance, if uncertainty exists about individual commodity prices independent of uncertainty about the price level, the incentives for indexation are altered. Labour still has the same incentive because its interest lies only in the price level. In fact the incentive may become even stronger if it is more difficult to predict the price level when relative prices are changing. Nevertheless, the incentives for the firm may well be diminished because it can no longer count on the fact that all prices move together. If the price of its

commodity and the price level are totally unrelated, then the firm faces two distinct sources of uncertainty when indexation is adopted: uncertainty about the commodity price and uncertainty about the price index. Without indexation, it faces only the former; thus indexation increases the value of the last term in the above formula and reduces expected utility. An even stronger disincentive would arise if individual commodity prices and the price level are negatively related, which would add a third element in the last term because in this case revenues and costs move in opposite directions and the added disutility of an increase in costs at a time of decreased revenues is greater than the additional utility derived from increased revenues and decreased costs when risk aversion is present.

If wage indexation is adopted through nationwide bargaining, it is likely that relative price changes will be given less weight than absolute price changes and in those instances firms with private disincentives for indexation may still be pressured into cost-of-living clauses in their contracts.

There are circumstances when even labour unions would not find it advantageous to press for indexation. Suppose that there exists uncertainty about employment in the sense that the number of hours worked during a period of time can only be predicted with some random error. Any shock which reduces hours worked below those predicted would

reduce the expected utility for workers who maximize the expected real value of labour income. But wage indexation does not eliminate this source of uncertainty. Instead, risk-averse behaviour would dictate demands for "layoff benefits" such as those incorporated in recent UAW agreements with the automobile industry.

From this discussion and the more formal analysis of Appendix III, two general conclusions about the prevalence of indexation can be stated:

(i) Labour unions find indexation favourable under more sets of circumstances than do firms.

(ii) The more dominant are uncertainties pertaining to nominal variables (e.g., the price level) the greater is the likelihood of indexation being adopted because of its advantages to both labour and management.

This last conclusion can be related to the previous discussion of macroeconomic performance with and without indexation in Section 4. For nominal shocks, indexation reduces the variability of total output and employment. Private incentives exist to provide this social benefit. When real shocks, including random changes in relative prices occur, indexation does not necessarily improve the performance of the economy. At the same time incentives for firms to adopt indexation are also reduced so that again social and

private goals coincide, but conflict arises between workers who continue to have an incentive for indexation in the face of some types of uncertainty and management who have such an incentive only with "pure" inflation. The role of government in these circumstances is minimal. It should neither encourage nor discourage indexation, nor should it take sides in individual labour disputes involving indexation because it will be adopted only when both sides are convinced of its virtues.

6. WAGE DETERMINATION IN AN INFLATIONARY ENVIRONMENT

In the previous three sections, the role of indexation was explored in the context of economic models for which an equilibrium price level prevailed at all times. The typical comparative-statics exercise involved an exogenous shock to the system, composed of aggregate demand and supply relationships, which resulted in a new level of output and prices. Without wage indexation, the wage rate either remained constant or rose less than the induced increase in the price level; with indexation, the nominal wage rose as much as prices leaving the real wage unaltered. Then comparisons were made as to the qualitative and quantitative effects of indexation. Many useful conclusions were derived from this method of analysis, particularly the benefits and costs of wage indexation when the economy was subjected to a variety of different random shocks. However, there is one major limitation to the comparative-statics framework; the passage of time is irrelevant, and as a result the delay of wages responding to prices is not considered.

Yet wages change over time either to maintain equilibrium in the labour market or to restore it. These dynamics of wage inflation allow us to explore another dimension of indexation, namely the timing of increases in nominal wages. We will continue to assume that the only type of indexation is complete indexation. In an inflationary environment this

implies instantaneous indexation, that is nominal wages adjust at the same speed as prices. This, of course, is not a practical possibility and its adoption is only considered a useful analytical formality since we wish to make a clear distinction between wage inflation with and without indexation. Without indexation, wages will rise in response to price inflation but with a lag because new contracts have to be negotiated or because existing contracts allow for only periodic increases in wages. Therefore, it is necessary to define indexation in such a way so as to reduce this lag, or, for simplicity, to eliminate it altogether so as to increase the quantitative precision of the comparison between the two systems of wage determination.

6.1 The Scandinavian Model of Wage Determination

The most common framework for wage determination during the past 20 years has been the Phillips curve. However, its usefulness for open economies has been questioned from time to time and other explanations of wage inflation have been put forward. These explanations tend to take into account more explicity the special circumstances of an SOE, namely the incidence of imported inflation. The "Scandinavian model" -- so named because its proponents were Scandinavian economists [see Edgren *et al*. (1973)] -- is the best-known and most detailed of these models.

Before turning to an explanation of this model and the role of indexation in it, it should be noted that it assumes continuous equilibrium in the labour market, unlike the Phillips-curve analysis where wages respond to a disequilibrium situation. Thus the Scandinavian model does not have a trade-off between inflation and unemployment.

In this model, the distinction between tradables and nontradables (often called unsheltered and sheltered industries) is again important. The key ingredient of the analysis is that wage increases are decided in the tradable industries on the basis of factors that are particular to those industries and then, because of labour mobility throughout the economy, these wage increases are passively accepted in the nontradable industries. The size of the wage increase is equal to the inflation rate of tradable goods plus the rate of increase of labour productivity in that sector. Using $(\cdot)$ to denote the rate of change of a variable over time, we can write this relationship as

$$\dot{w} = \dot{p}_t + \dot{c}_t \qquad (6.1)$$

where $\dot{w}$, $\dot{p}_t$ and $\dot{c}_t$ are respectively, the growth rates of wages, prices of tradables and productivity of labour in tradables. (It will be assumed, for the time, that fixed exchange rates prevail so that $\dot{p}_t = \dot{p}_t^*$, the increase in world prices of tradables, an exogenous variable for the SOE.)

No real bargaining over nominal wages is involved in this process, although unions and management may have different views about the "true" magnitudes of the variables on the right-hand side of (6.1). Hence $\dot{w}$ determined by the Scandinavian model is an "equilibrium settlement." If $\dot{w}$ is higher than that dictated by (6.1) the tradable industries become uncompetitive in international markets, unless the excess labour costs are offset by cost reductions elsewhere. Scarfe (1973) uses this idea to introduce a Phillips curve into the model. He stipulates that the size of $\dot{w} - \dot{p}_t - \dot{c}_t$ dictates the extent of unemployment because the larger the expression the less competitive are the tradable industries, forcing them to reduce output. This fact underscores the importance of wage determination in the tradable sector rather than the nontradable sector, where output prices are not constrained by international competitiveness. Once wages are decided, the price increase for nontradables emerges from a mark-up calculation, taking into account productivity growth in the nontradable sector:

$$\dot{p}_n = \dot{w} - \dot{c}_n \qquad (6.2)$$

Since wage determination in (6.1) is assumed to occur prior to the price determination of (6.2), the variables on the right-hand side of this equation can be treated as exogenous.

To calculate the effect on overall inflation we use the rate of change of equation (3.10), with constant weights:

$$\dot{p} = \dot{p}_t + (1-k)\dot{z} \tag{6.3}$$

and remembering that

$$\dot{p}_n = \dot{p}_t + \dot{z} \tag{6.4}$$

so that (6.2) becomes

$$\dot{z} = \dot{p}_t - \dot{w} + \dot{c}_n \tag{6.2'}$$

Substituting (6.1) into (6.2') produces

$$\dot{z} = \dot{c}_t - \dot{c}_n \tag{6.5}$$

which when substituted into (6.3) yields

$$\dot{p} = \dot{p}_t + (1-k)(\dot{c}_t - \dot{c}_n) \tag{6.6}$$

From this final equation a number of conclusions can be drawn: (i) the domestic rate of inflation is not necessarily equal to the "world" rate of inflation as represented by $\dot{p}_t$. Only if productivity growth were equal in the two sectors would $\dot{p} = \dot{p}_t$. But typically $\dot{c}_t > \dot{c}_n$, because nontradables include service industries where growth in labour productivity is quite low or nonexistent. Thus domestic inflation will usually exceed world inflation; (ii) world inflation gets fully transmitted to the SOE no matter how small the size of the tradable sector is because $\dot{p}_t$ determines wages in both

sectors; (iii) the real wage from the point of view of the firms in each sector rises only to the extent of productivity growth in that sector leading to constant employment in each sector; (iv) the real wage from the point of view of labour is determined by

$$\dot{w} - \dot{p} = k\dot{c}_t + (1-k)\dot{c}_n \qquad (6.7)$$

so that the real wage rises by the weighted average of productivity in both sectors.

What difference would wage indexation make to these results? The incentive for indexation, on the part of labour, exists to the extent that $\dot{p} > \dot{p}_t$ so that in equation (6.1) the real wage rises by less than productivity growth in the tradable industries. Given sufficient union strength, equation (6.1) could be replaced by a process involving full indexation such as

$$\dot{w} = \dot{p} + \dot{c}_t \qquad (6.1')$$

The overall rate of inflation [derived from substituting (6.1') into (6.2) and solving with (6.3) simultaenously for $\dot{p}$ and $\dot{z}$] becomes

$$\dot{p} = \dot{p}_t + (1/k)(1-k)(\dot{c}_t - \dot{c}_n) \qquad (6.8)$$

Compared to (6.6) inflation with indexation is higher, if as argued earlier $\dot{c}_t - \dot{c}_n$ is positive and as long as $k < 1$.

As a result, indexation is undesirable on two counts: (i) it causes the tradable sector to become uncompetitive in world markets because labour costs are increasing at a faster pace than in the rest of the world; (ii) the rate of inflation is higher than it would be if wages were determined in a competitive environment. Without indexation, real wages increase in accordance with productivity growth for the economy as a whole, as seen by equation (6.7). On the other hand, wage indexation of the type shown in equation (6.1') really involves a bargain that <u>increases</u> real wages rather than merely <u>protecting</u> real wages against unanticipated inflation.

As long as the tradable industries in an SOE are aware of the price-taker constraint that they face, no strong legislative action need be taken to prevent indexation of the kind shown in (6.1'). Both unions and management in tradable industries realize that any uncompetitiveness may lead to large (theoretically infinite) reductions in output and employment in these industries. Only to the extent that some monopoly-monopsony power exists in world markets, is there a "reasonable" trade-off between higher real wages and unemployment. In Section 2.4.1 it was argued that price-maker power in Canadian tradable industries was slight, so that wage indexation is unlikely to occur if wage determination in Canada is to follow the Scandinavian model.

For the sake of simplicity, the analysis so far has assumed a fixed exchange rate so that $\dot{p}_t$ could be treated as exogenous. With a flexible exchange rate

$$\dot{p}_t = \dot{p}^*_t + \dot{r} \qquad (6.9)$$

where r is the exchange rate ($\dot{r} > 0$ implies a depreciation over time of the domestic currency) and p^*_t is measured in the foreign currency. When substituted into (6.6) the overall of inflation with flexible rate is

$$\dot{p} = \dot{p}^*_t + \dot{r} + (1-k)(\dot{c}_t - \dot{c}_n) \qquad (6.6')$$

Thus by controlling $\dot{r}$ through domestic monetary policy, an SOE can have an inflation rate of its own choosing. As the "monetary approach" to exchange-rate determination suggests, a reduced growth of the money supply leads to an appreciation of the domestic currency and a reduction in the inflation rate. In other words, with flexible rates, the domestic monetary authorities can follow a monetary rule to eliminate external inflationary pressures. As a case in point, the target range for the growth of the money supply used by the Bank of Canada since 1975 would not be possible without the increased "flexibility" of the Canadian dollar in foreign exchange markets.

If wage indexation is established, the flexibility of the exchange rate could be used to mitigate the increasing uncompetitiveness of tradable industries when (6.1') is used

to determine wage increases. Thus, if $\dot{r} = \dot{p} - \dot{p}_t$ then the tradable industries can be kept on the "knife-edge," but the monetary authorities again lose control over the domestic rate of inflation.

6.2 The Expectations Augmented Phillips Curve

Unlike the Scandinavian model which is predicated on the proposition that wage increases are limited by the equilibrium condition in the labour market, the Phillips curve analysis stresses the role of excess supply in the wage determination process as a means of restoring equilibrium in the labour market. For our purposes, it is not necessary to review the extensive literature, both theoretical and empirical on the Phillips curve. [For the most recent study on the Canadian Phillips curve, see Auld et al. (1979).] The aim of this study is to concentrate on those aspects of the Phillips curve that are affected by wage indexation.

The expectations-augmented Phillips curve, -- the most general statement of that relationship -- can be written as

$$\dot{w} - \dot{\bar{p}} = a + bu \qquad (6.10)$$

where $\dot{\bar{p}}$ is the expected rate of inflation over the time period for which the nominal wage increase applies and u is the unemployment rate, the typical variable used to depict excess supply conditions in the labour market. Thus $\dot{w} - \dot{\bar{p}}$ represents the increase in the expected real wage from the worker's point

of view. This variable is negatively related to the rate of unemployment, based on the dynamic process in which the greater the excess demand (or the smaller the excess supply), the greater is the rate of increase of the price in that market. There is one level of u for which the expected real wage is constant ($u = -a/b$), in the absence of productivity growth. This is called the natural rate of unemployment. To the extent that predictions of inflation are accurate and fully incorporated in nominal wage bargains, the economy remains at the natural rate. Hence deviations from this rate through stabilization policy must rely on manipulating the real wage. This is the main message of the "new macro-economics."

In a recent study, Auld et al. (1979) suggest that Canadian wage settlements for the period 1966 to 1975 do not follow the predictions of the expectations-augmented Phillips curve for two reasons: (i) in addition to future expected inflation, wage contracts include a "catch-up" for "uncompensated" inflation in the past and (ii) "...a fully anticipated steady 10 per cent rate of inflation... generates a wage inflation of 7.3 per cent." (p. 73) As a result, ex ante and ex post adjustments to inflation are incomplete and for given labour market conditions, the real wage declines in

equilibrium. According to their specification, equation (6.10) should be amended by putting a coefficient of less than one in front of and adding a "catch-up" variable so that

$$\dot{w} = a + bu + d\dot{\bar{p}} + h(\dot{p}(t-1) - d\dot{\bar{p}}(t-1)) \qquad (6.11)$$

where the last term captures the uncompensated inflation of the previous period that is included in the current wage bargain. On the basis of a regression on data for 2 338 contracts without COLA clauses in the private sector, they estimate d = .371 and h = .570, implying that ex post adjustments are more important than ex ante adjustments. They observe that "It should be obvious that the catch-up variable is not unlike a COLA clause, the difference being that the former is negotiated at the beginning of the next contract, while the latter is formally imbedded into the current contract." (p. 64) It should be noted that their results depend crucially on the assumed expectations process. They state, "It is assumed that expected (the word "actual" here is an obvious misprint) price inflation at time t can be described by a distributed lag of past values of inflation and an error term." (p. 86) This indicates that, like many other studies involving unobservable expectations variables, their's is a test of a joint hypothesis: that the expectations process is "correct" and that the "catch-up" variable is significant. According to their specification, expectations contain a

systematic error (in the sense that rising inflation produces a larger positive error and falling inflation a larger negative error, as shown in their Chart 2) which, not surprisingly, is "corrected" in nominal wage adjustments after the fact. If, however, expectations contain only a random error, the "catch-up" variable may no longer be significant and ex ante adjustments may be larger. In view of the rather elaborate exploration of other issues, it is somewhat disappointing that the authors of this study did not concern themselves more with the problems of formulating expectations processes.

Nevertheless, let us take these results as correctly descriptive of the wage determination process in Canada during the recent past. What are the implications of full wage indexation to these results? There are two sets of important implications: (i) indexation eliminates errors in predictions about inflation and hence eliminates the necessity of "catch-up" increases in nominal wages, and (ii) complete indexation would eliminate the reduction in the equilibrium real wage and an activist role for stabilization policy.

According to the results of the Auld study, an increase in inflation is only slowly incorporated into nominal wage bargains, much of it not until the next contract. From the previously cited regression results, only about a third of anticipated inflation is fed into the present increase in nominal wages and only 73 per cent of actual inflation is

incorporated ultimately into nominal wage increases. Wage indexation of as low as 75 per cent would better protect the real wage than the present system of partial *ex ante* and partial *ex post* adjustments. Moreover, Auld *et al*. concluded that wage adjustment to inflation was incomplete even in equilibrium. This suggested that the long-run Phillips curve for Canada during this period was negatively sloped leaving some scope for stabilization policy to move the economy below the natural rate of unemployment, although the authors are not too optimistic about finetuning the economy in the long run. With complete indexation, however, the long-run Phillips curve is vertical. Starting at the natural rate of unemployment ($u = -a/b$), $\dot{w} = \dot{p}$ instead of $\dot{w} = \dot{\bar{p}}$ as in equation (6.10). [With indexation, equation (6.11) would be irrelevant because "catch-up" variables no longer make sense.] If the economy started at a rate of unemployment lower than the natural rate, then $\dot{w} > \dot{p}$, but this very fact would move the economy back to the natural rate because disproportionately rising labour costs reduce the demand for labour. As a result, $\dot{w}$ and u are divorced from each other and the Phillips curve is vertical at the natural rate, even in the short run if wages adjust immediately to inflation. In a situation where indexation substitutes for anticipations and "catch-up", the negatively sloped Phillips curve would only reappear if indexation were incomplete, or in the short run, if there are lags in the application of COLA clauses.

It is quite possible that the period of 1966 to 1975 represented a learning process in terms of inflationary expectations and that the decline in the real wage due to inflation is peculiar to that period. If predictions about inflation improve in quality it is much more likely that the real wage will not decline in the long run. In this context, wage indexation plays a more restricted role in reducing lags and errors in the wage determination process, without affecting the final outcome.

6.3 The Phillips Curve in an SOE

The Phillips curve discussed so far does not incorporate the special features of an SOE and in this section, the necessary amendments will be made. In addition, the Phillips curve will be transformed into an aggregate supply curve, which together with an aggregate demand curve will determine equilibrium output and inflation (instead of the price level as in Section 3.2).

The Phillips curve of equation (6.10) remains as the basis for the aggregate supply curve. We require an additional relationship between wages and prices, rewriting (6.7) as

$$\dot{p} = \dot{w} - \dot{c} \qquad (6.7')$$

where $\dot{c}$ is the growth rate of labour productivity in the economy as a whole. We also need a relationship between unemployment and output. In a one-sector economy there is a

simple inverse relationship between these two variables, but in a two-sector model we separate the outputs so that

$$u = u(Q_t, Q_n) \tag{6.13}$$

Increased output of either sector reduces unemployment because it increases demand for labour, but not necessarily equally. If nontradables are labour-intensive compared to tradables, then a given increase in nontradables output reduces unemployment more than an equal increase in tradable production. Using our definition of total output

$$y = Q_t + zQ_n \tag{6.14}$$

we can substitute for Q_t in (6.13) and write

$$u = u(y - zQ_n, Q_n) \tag{6.13'}$$

Substituting (6.6') and (6.13') into (6.10) the aggregate supply curve becomes

$$\dot{p} = a - \dot{c} + bu(y - zQ_n, Q_n) + \dot{\bar{p}} \tag{6.15}$$

This relationship is shown as the S curve in Figure 6.1, where the vertical axis is now the rate of inflation, rather than the price level. The relationship between p and y is positive since $b < 0$ and $u'_y < 0$, holding all other factors constant, including, in particular, expectations about inflation. These other factors generally influence the location of the supply curve. An increase in c shifts the curve to the right because a larger total output can be produced with the same labour force and this leaves prices unaffected even though wages rise. An increase in Q_n, with y constant, implies that Q_t

must fall so that the composition of total output has changed. This has ambiguous effects on the location of the supply curve. If nontradables are labour-intensive, an increase in Q_n will shift the curve to the left because increased demand

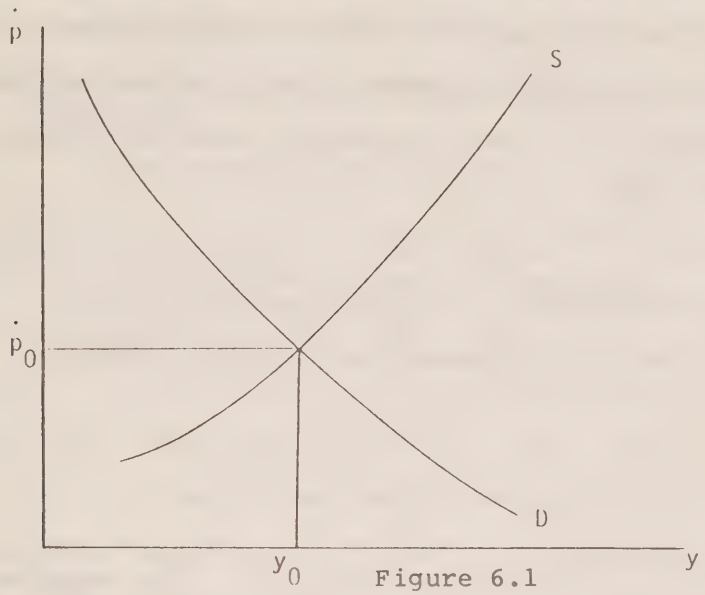

Figure 6.1

Equilibrium Output and Inflation in an SOE

for labour occurs. (See Appendix IV for a derivation of these results.) An increase in z with y and Q_n constant also requires a reduction in Q_t to allow for an increase in non-tradable output, measured, in this case, in units of tradables; it has the effect of shifting the supply curve to the left. Finally, an exogenous increase in expected inflation shifts the supply curve to the left, because of its effect on nominal wage increases and ultimately on actual inflation. But expectations about inflation are unlikely to be exogenous; they are

strongly influenced by actual inflation. In the long run they coincide requiring that $\dot{\bar{p}} = \dot{p}$ and the aggregate supply curve becomes vertical at a level of output consistent with the natural rate of unemployment and for a given composition of output. In the short run, if anticipated inflation lags behind actual inflation the aggregate supply curve will retain its positive slope, but it will be steeper than in the case of exogenous expectations.

The aggregate demand curve is derived from equation (3.13'). Taking proportional changes over time of this equation, as suggested by Dornbusch and Fischer (1978), produces

$$\dot{e} = e(t-1) + g\dot{G}_n + m(\dot{M} - \dot{p}) + s(\dot{B} - \dot{p}) \qquad (6.16)$$

This is the demand curve drawn in Figure 6.1. Its negative slope is derived from the fact that an increase in the inflation rate reduces the real money supply and the real value of bonds, thus causing expenditures to decline. Total expenditures in the current time period are equal to those of the previous period plus those stimulated by growth in government expenditures, and money and bond supplies. An increase in any of these categories shifts the demand curve to the right. Bond-financed growth in government expenditures involves $\dot{G}_n = \dot{B}$. Expansionary monetary policy over time (under flexible rates only) requires $\dot{M} = -\dot{B}$, but the net effect on total expenditures is positive because $m > s$.

Intersection of the two curves determines equilibrium. A given level of output, with a fixed composition, is produced and the economy experiences a rate of inflation equal to $\dot{P}_0$. This equilibrium assumes that all other variables remain constant, including the expected rate of inflation.

6.4 Macroeconomic Performance in an SOE with Inflationary Tendencies

Whenever the equilibrium in Figure 6.1 is disturbed by an exogenous shock to either the aggregate supply curve or aggregate demand curve or both, adjustments in output and the inflation rate will take place until a new equilibrium is reached. Our main concern in this section is to compare this adjustment path without and with wage indexation.

For our first experiment, consider a shift in the aggregate demand curve created by an increase in the growth rate of the money supply. It must be remembered that this is an exogenous event only with flexible exchange rates. In Figure 6.2 the demand curve shifts to D_1, leading to a higher level of output and increased inflation. (Appendix V generates these and the following results algebraically.) However the economy does not settle down at E_1. With higher actual inflation, expectations will adjust, shifting the supply curve to the left. Also, in subsequent periods the demand curve may shift, -- upwards because e(t-1) is now higher and downward because $\dot{M}$ is now constant at the higher level. Ultimately, the economy reaches a new final equilibrium at E_2 where y is

unchanged from its initial level and the increase in inflation, now fully anticipated, is equal to the increase in the growth rate of the money supply. As a consequence, expansionary monetary policy has been able to reduce the unemployment rate below the natural rate temporarily, but not permanently.

Assume now the same experiment but in the presence of full wage indexation. In this case, expectations about inflation are replaced by actual inflationary experience and $\dot{p} = \dot{\bar{p}}$ is substituted in (6.15). An increase in $\dot{M}$ moves the economy immediately from E_0 to E_2 in Figure 6.2 because the

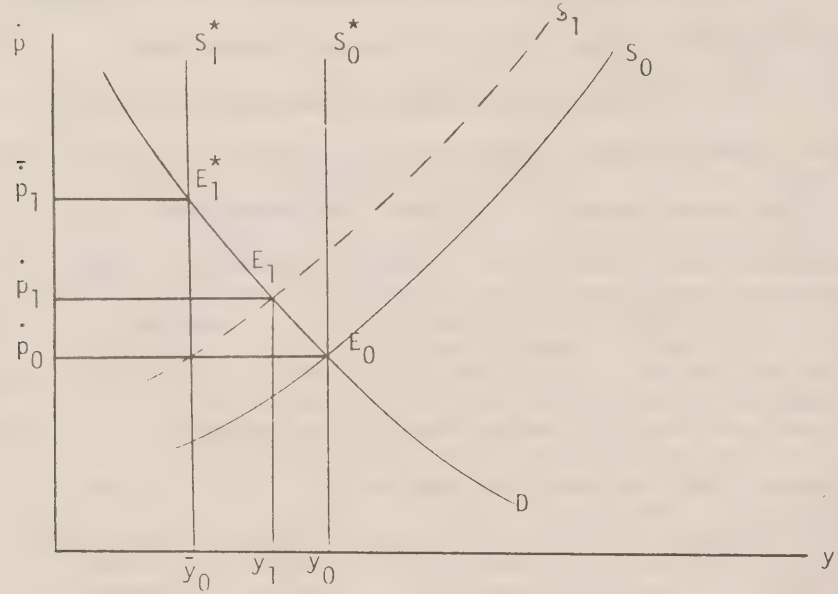

Figure 6.2

The Rate of Inflation and Output After an Increase in the Monetary Growth Rate

supply curve is vertical. Hence what happens in the long run without indexation occurs immediately with indexation, eliminating an activist role for stabilization policy even in the short run.

Expansionary fiscal policy is much more difficult to define in this context and depending on the assumption made it can shift both the supply curve and the demand curve. On the supply side, an instantaneous increase in the demand for non-tradables increases Q_n, z and perhaps y creating an ambiguous effect on the supply curve. On the demand side, an increase in the growth of government expenditures would shift only temporarily the demand curve to the right. For simplicity, it is assumed that the demand curve stays in place and that the shift in the supply curve is to the left in Figure 6.3.

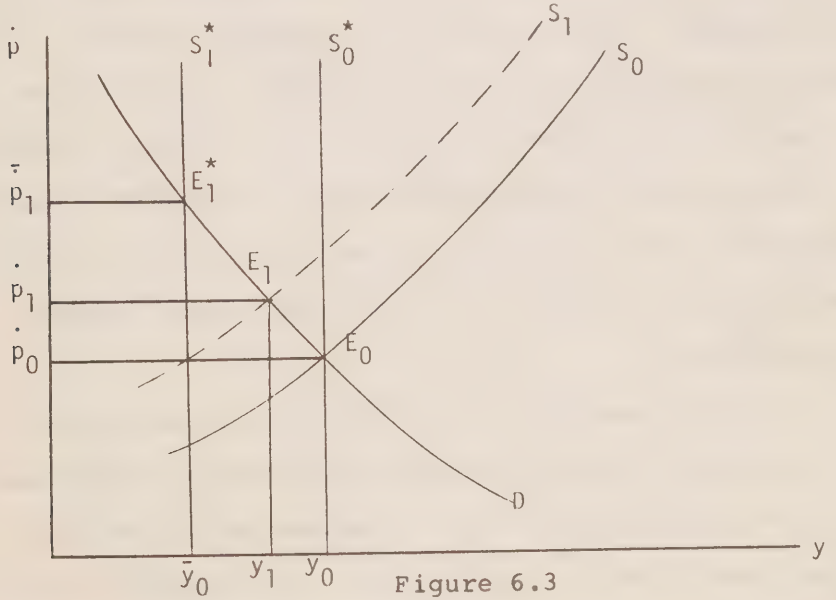

Figure 6.3

Impact Effects on Output and Inflation of Expansionary Fiscal Policy

Without indexation the new temporary equilibrium is at E_1 with a higher rate of inflation but reduced output. This situation should not be considered "stagflationary" in the sense that this word is used today, because unemployment has not increased. The same labour force is employed, but because nontradables are labour intensive, a smaller total level of output can be produced when the composition changes to a greater proportion of nontradables. In the long run the inflation rate must be reduced again to $\dot{p}_0$ because the money supply continues to grow at the previous level but total output can remain below y_0.

With indexation, the supply curve will shift to the left, by an equal horizontal amount from s_0^* to s_1^*, leading to higher inflation and a greater reduction in output than without indexation. Of course, it is possible that the expansionary fiscal policy shifts the supply curve to the right, in which case indexation results in a larger positive change in output and a larger reduction in inflation compared to a situation without indexation. As in Section 3, information about factor intensities of the two sectors would clarify the outcome.

In Gray's analysis, the role of indexation as a means of insulating the real economy from random shocks was stressed. In the present context, the shocks are policy induced and insulation is undesirable. As a result, indexation blunts and even eliminates the effects of policies that

operate through the aggregate demand curve, while it accentuates the effects of policies that operate through the aggregate supply curve. But in an SOE, with two sectors, we have seen that macroeconomic policy can change the composition of output and as a result it can influence the rate of inflation and total output, if only temporarily.

7. OTHER ISSUES CONCERNING INDEXATION

Since COLA clauses seem to be incorporated in more and more labour contracts, it is safe to presume that indexation is going to continue to grow in the future. As a consequence there is some merit in considering desirable characteristics of COLA clauses before force of habit makes it impossible to abandon inferior features in indexation schemes. Some of these characteristics are taken up in this section.

7.1 Proportional Changes in Nominal Wages

The real wage is a ratio of the nominal wage rate divided by a price index. In order to prevent erosion of the real wage through inflation -- presumbaly the main purpose of indexation -- it is necessary that the nominal wage change in the same proportion as the price index. Yet, as we have seen, many contracts contain COLA clauses that require absolute changes in the nominal wage in relation to changes in the absolute value of the index. Given the availability of computerized pay-roll calculations there does not seem to be a good reason for this procedure which makes it difficult for workers to determine the extent of the protection of the real wage. Also a "cents-per-point" COLA clause favours low-wage workers over those with higher wages and leads to higher protection nearer the end of a contract than at the beginning as a one-point change in the index becomes a smaller proportional change over time. For example, a recent one-point

change (March, 1979) when the CPI was 186.6 represents only a .54 per cent change, compared to three years earlier when the CPI was 146.6 for which a one-point increase translates into .68 per cent.

The use of "thresholds" and "caps" also prevents cost-of-living adjustments from being proportional to inflation, but their use may not be based merely on administrative convenience as is the "cents-per-point" convention. One could argue that these characteristics are used as the "fairest" way of keeping down the cost of indexation. One could also argue that COLA clauses without caps involve too much risk for firms if relative price changes accompany "pure" inflation. Some clauses specify a minimum COLA payment regardless of the increase in the CPI. This "guarantee" feature also destroys proportionality and should be considered a special fringe benefit and not a legitimate part of indexation.

7.2 Choice of a General Price Index

The purpose of COLA clauses is to protect the purchasing power of workers as consumers. In this regard, the Consumer Price Index, based on a typical basket of goods and services, is the best available for the purpose. Other indices, such as the Wholesale Price Index or the Gross National Expenditure deflator or the Final Domestic Demand deflator are either too wide or too narrow in coverage of items relevant for the consumer to be an acceptable substitute for the CPI.

The CPI is calculated for "all items" and for various subcategories. It would seem sensible to use the most inclusive category unless it can be argued that some items are given too much or too little weight from the point of view of the particular group to be covered. For instance, special COLA clauses may be necessary for workers who receive room and board as part of their compensation or who, on the basis of their place of work (e.g., an isolated location) have special expenditure patterns.

Despite its superiority over other available indices, the CPI is not a "perfect" measure of the cost of living. It is usually biased upward to an unknown extent. In an initial base period, weights for each item in the "basket" are chosen on the basis of average consumer expenditures on these items and these weights are held constant thereafter. But relative prices are changing as well as absolute prices in subsequent periods. Hence consumers will substitute goods and services with relatively lower price increases for those that have had higher than average price increases. As a result, the weights attached to the relatively expensive items are too large and the weights given to the relatively cheaper items are too small so that the price index with the original weights is biased upward compared to one that used the "true" weights. In Canada, the CPI weights are revised from time to time, most recently starting with the index for October 1978 when the expenditure patterns of 1974 replaced those prevailing in 1967.

In explaining this procedure, Statistics Canada in its publication The Consumer Price Index - Revision Based on 1974 Expenditures, pointed out,

> The previously published Consumer Price Index for Canada is actually not revised; rather it remains the official measure of consumer price change at the national level to September 1978.... The 1974 weighted series serve as the official measure of consumer price change beginning with the October over September 1978 change onward. (p. 3)

The revision of previously published figures for the CPI, if undertaken, could necessitate repayment of previously paid COLA allowances, since in almost all cases the new index is lower than the old. In addition, revision of the series may be interpreted as "tampering" with the CPI reducing its impartiality as a measure of the rate of inflation.

Moreover, to avoid an abrupt change in the price index when the new weights are introduced, a system of "chain-linking" the old and the new indices is used. This involves multiplying the index for September 1978, the last month of the index using 1967 weights, 177.5, by one plus the change from September to October using the 1974 weights to arrive at the new index for October of 179.3. Without this procedure, a reduction in the price index may have taken place because the elimination of the upward bias would probably have been stronger than the price increase in that month. For instance, the old index in August 1978 was 177.8 while the new index

calculated for September was 173.0, a decline of 2.7 per cent in one month in the price level if chain-linking were not used to smooth the adjustment from the old to the new index.

It could be argued that in the face of unusually large increases in food and energy-related prices throughout the 1970s a revision of the CPI weights should have been carried out earlier to prevent the CPI from getting too far out of line as a "true" measure of inflation. For instance, in 1977 the old index was, on average, .7 per cent higher than the new 1974-based index. One can only guess at the reduction in COLA payments that would have resulted from the adoption of the new index a year or two earlier.

7.3 Choice of a Regional Price Index

The CPI is calculated for a number of urban centres across Canada: St. John's, Charlottetown/Summerside, Halifax, Saint John, Quebec, Montreal, Ottawa, Toronto, Thunder Bay, Winnipeg, Regina, Saskatoon, Edmonton, Calgary and Vancouver. These indices show considerable variations in prices of individual commodity groups. In some instances the cause is transportation costs. For instance, the sub-index for food for home consumption in St. John's was 115 per cent of the all-city average in September 1978. In other cases, the lack of opportunity for arbitrage creates divergent trends over time. By March 1979, the price index for housing in Edmonton

had risen to 200.2, Vancouver's housing index was 186.1, Montreal's was 172.5 and St. John's was only 153.8, all from a base of 1971 = 100, reflecting the differences in housing market conditions in these cities in the 1970s.

As reported in Section 1.4.2, most COLA clauses are geared to the all-Canada CPI. However, since nominal wages differ among regions because of labour market conditions and other factors, COLA clauses should also use a regional CPI. The present procedure means that the real wage is falling in areas with higher-than-average increases in the local CPI, while it is rising in areas with below-average inflation. Although this trend may be considered beneficial because it reduces real wage differentials between "rich" and "poor" areas of the country, COLA clauses should not be used as an instrument of reducing or eliminating regional disparities, subverting its primary purpose of maintaining a given real wage at a given place in the face of inflation. With greater publicity as to its availability, it should be possible to encourage participants in labour negotiations to use the CPI for the city in which the work place is located, reverting to the all-Canada CPI only for rural areas and urban centres not covered by the present system.

7.4 The Use of a Special Price Index

It was suggested earlier that the CPI is the best index to use for wage indexation because it most accurately reflects the cost of living of the average consumer. However,

in view of the earlier argument that macroeconomic stabilization is best served if wages adjust for nominal shocks but not for real shocks, and given the fact that the CPI incorporates the price effects of both kinds of shocks, is there a case for designing a special price index that concentrates on price changes created by nominal disturbances? Fischer (1977, p. 134) suggests, "an index excluding import prices and indirect taxes, such as a price index of domestic value added, might be appropriate." Nevertheless, such an index may find little acceptance if it is believed to be politically motivated by an effort to increase the ability to manipulate the real wage. Moreover, it is not possible to filter out of any price index all conceivable real shocks and any attempt to adjust the index for previously unrecognized events will cause the index to fall into disrepute and disuse. As a consequence, despite its many failings, the CPI may be the best index for COLA clauses because it is widely believed to be the best.

8. SUMMARY AND CONCLUSIONS

The discussion in this study has covered a broad range of theoretical and practical issues, but the main theme throughout has been the exploration of the effects of wage indexation on the macroeconomic performance of a small open economy in a variety of settings. The SOE is characterized by a two-sector model in which the relative price of nontradables is an important endogenously-determined variable. Also, the performance of an SOE differs markedly under flexible exchange rates and fixed exchange rates. The effects of indexation were established on the basis of a comparison of the impact of various exogenous random shocks and policy changes on two models, identical in every respect except for the process by which the nominal wage rate is determined. One model incorporated full and immediate adjustment of nominal wages to maintain a constant real wage in the face of price increases as would occur with indexation, while the other model allowed nominal wages to adjust partially to price increases in the event of predictable policy changes or not at all in the event of unpredictable random shocks to the economy. Although most of the analysis was formulated in terms of once-and-for-all price increases created by these events, the substitution of inflation in the analysis made little difference to the conclusions about the effects of indexation on the macro-

economic performance of an SOE except for the issue of timing in the sense that indexation, by adjusting the nominal wage continuously, can replace both ex ante and ex post inflationary effects on the real wage.

The main conclusion to be derived from this study is that wage indexation is a mixed blessing: it provides superior results compared to nonindexation in some sets of circumstances and inferior results in others. It has many of the same attributes as "built-in stabilizers" or "monetary rules" which require no active intervention for their operation and hence are not subject to human error, but they also introduce an element of inflexibility at times when deliberate judgment, despite its propensity for errors, is required to arrive at the optimum solution for a particular problem. Given its importance, some elaboration of this point is in order.

The principal effect of wage indexation is to maintain a constant real wage in the face of price changes. With a constant real wage, firms will maintain a given level of employment and a constant stream of goods and services. As a result the aggregate supply curve is vertical creating a dichotomy between the price level on the one hand and real variables such as employment and output on the other hand. This is a desirable feature of indexation if the main purpose is to defend the existing level of employment and output against exogenous demand shocks. In other words, indexation

insulates these important real variables against purely monetary events; no matter how high or variable the rate of inflation becomes, no matter how difficult it is to predict inflation rates for a two- or three-year labour contract, indexation protects the real wage against these economic uncertainties.

But the main difficulty with indexation is that it cannot discriminate between the purely monetary event of inflation when the real wage should remain constant and other exogenous events or policy initiatives when an increase or decrease in the real wage through adjustments in the general price level is necessary and/or desirable. It is all too evident that indexation cannot be turned on and off as these circumstances vary. It is not possible, for obvious reasons, to incorporate COLA clauses in labour contracts that stipulate adjustments in the nominal wage whenever price increases are purely monetary events, but not otherwise. Mainly because of the inability to discriminate between nominal and real events merely on the evidence of price increases Gray (1976, pp. 232-3) suggested partial indexation as the optimal solution. This problem of determining the ultimate cause of price increases is compounded for a small open economy in which a change in the relative price of nontradables influences both the aggregate demand curve and aggregate supply curve, requiring a new equilibrium level of output and prices, creating uncertainty about the benefits of indexation and

suggesting that partial indexation is the optimal solution for SOEs as well. In this light it is perhaps not too surprising to find that most contracts incorporate COLA clauses with less than full indexation.

While the Canadian economy has been dominated by inflationary pressures during the last decade or more, other economic events important to the wage-determination process have not been absent. Moreover, it is often difficult to interpret actual events in terms of this distinction. For instance, the sizeable depreciation of the Canadian dollar during 1977 and 1978 has undoubtedly contributed to the increase in the cost of living during these years. With indexation, nominal wages would adjust to offset the reduction in the real wage stimulated by the depreciation. However, it could be argued that this decline in the value of the Canadian dollar represented a belated adjustment in relative prices, making tradables again more competitite in world markets, but only if nominal wage changes are less than the inflationary effects of the depreciation.

In view of the ambivalence towards indexation raised by the analysis in this study, should the government encourage or discourage COLA clauses in private-sector labour contracts? The answer is that the government should take a neutral stance on this issue. It should leave the decision to the bargaining process because the self-interest of the bargaining opponents tend to coincide with the interests of the economy as a whole.

At times when pure inflation is the dominant factor in labour negotiations, both unions and management can see tangible benefits from indexation and it is likely to be incorporated in labour contracts, thus providing the insulation of the real economy from the inflationary effects. If, on the other hand, relative price shifts or productivity changes are important elements of the bargaining environment, either unions or management or both will have a disincentive for indexation thus allowing the economy to avoid the inflexibility of the real wage which would have created greater adjustment problems in moving to a new equilibrium.

APPENDIX I: Aggregate Supply Equation for an SOE

In a two-sector economy, aggregate supply depends not only on the supply of and demand for labour but also on its allocation to the two sectors and on differences in production characteristics between the two sectors. In this appendix, the aggregate curve is derived for this two-sector economy.

The production function for each sector can be written as

$$Q_i = f_i(N_i, \bar{K}_i) \qquad (i=t,n) \qquad (I.1)$$

where $\bar{K}_i$ is the fixed amount of capital during the short run.

$$N_i = g_i(w/p_i) \qquad (I.2)$$

represents the demand for labour, so that

$$Q_i = f_i[g_i(w/p_i)] \qquad (I.1')$$

where $f_i' g_i' < 0$ ($f_i' = w/p_i > 0$ and $g_i' < 0$). Taking proportional changes of (I.1') with ($\hat{}$) denoting this manipulation (e.g., $\hat{Q}_i = dQ_i/Q_i$).

$$\hat{Q}_i = \theta_{Ni}\, \eta_{Ni}\, (\hat{w} - \hat{p}_i) \qquad (I.3)$$

where $\theta_{Ni} = \dfrac{wN_i}{p_i Q_i}$ and $\eta_{Ni} = (\partial N_i/\partial w/p_i)(w/p_i)/N_i$.

For a linear homogeneous production function, with capital held constant and evaluated at $K = \bar{K}$ (omitting subscripts for i=t,n)

$$f_N N + f_{\bar{K}}\, \bar{K} = f(N,\bar{K}) \qquad (I.4)$$

Differentiating with respect to N yields

$$f_{NN} N + f_{\bar{K}N}\, \bar{K} = 0 \qquad (I.5)$$

Since $f_N = w/p$ and $f_{NN} = \partial(w/p)/\partial N$

$$\eta_N = - \frac{f_N}{f_{\bar{K}N}\bar{K}} \qquad (I.6)$$

According to Allen (1939, p. 343), the elasticities of factor substitution can be written as

$$\alpha = f_N f_{\bar{K}} \; / \; Q \; f_{\bar{K}N} \qquad (I.7)$$

so that

$$\eta_N = - \alpha \frac{pQ}{rK} = - \frac{\alpha}{1-\theta_N} \qquad (I.8)$$

where r is the return to capital. Substituting (I.8) into (I.3) we obtain

$$\hat{Q}_i = - \frac{\theta_{Ni}\alpha_i}{1-\theta_{Ni}} \; (\hat{w} - \hat{p}_i)$$

$$= \eta_i \; (\hat{w} - \hat{p}_i) \qquad (I.9)$$

where $\eta_i = - \theta_{Ni}\alpha_i/(1-\theta_{Ni})$ represents the supply elasticity in each sector.

Taking proportional changes of (3.7) in the text

$$\hat{y} = k \; \hat{Q}_t + (1-k)(\hat{z} + \hat{Q}_n) \qquad (I.10)$$

where $k = Q_t/y$ represents the share of tradables in total output as well as their share in the price index. Substituting (I.9) into (I.10)

$$\hat{y} = \eta(\hat{w} - \hat{p}_t) + (1-k)(1-\eta_n)\hat{z} \qquad (I.11)$$

where $\eta = k \; \eta_t + (1-k)\eta_n$ is the weighted supply elasticity for the whole economy. From equation (3.5) in the text we can write

$$\hat{w} = \omega(\hat{p}_t + (1-k)\hat{z}) \qquad (I.12)$$

where $0 < \omega < 1$ represents the adjustment of nominal wages to changes in the price level. Substituting (I.12) into (I.11) we obtain

$$\hat{y} = \eta(\omega-1)\hat{p}_t + (1-k)[\omega k(\eta_t-\eta_n) + \eta_n(\omega-1) + 1]\hat{z} \qquad (I.13)$$

Derivation of (3.11')

The general supply curve of (I, 13) can be used to derive (3,11') in the text. An increase in p_t (a rise in the price level with relative prices constant) leads to an increase in output as long as $\omega < 1$. Thus we have the positively sloped aggregate supply curve with money illusion and the vertical supply curve for the "classical case" ($\omega=1$). The effect of an increase in the relative price ($\hat{z} > 0$) on y depends on the sign of the expression $\eta_t - \eta_n$. If nontradables are labour intensive, according to Jones (1965), $\theta_{Nn} > \theta_{Nt}$ and if $\alpha_t = \alpha_n$ then $\eta_t - \eta_n > 0$ and $\hat{y} > 0$ unambiguously. Alternatively, if $\alpha_n > \alpha_t$, while $\theta_{Nn} = \theta_{Nt}$, then again $\eta_t - \eta_n > 0$. On the other hand, if tradables are labour intensive ($\theta_{Nt} > \theta_{Nn}$) and if these industries have a higher elasticity of factor substitution ($\alpha_t > \alpha_n$), it is possible that an increase in z creates a reduction in y because $\eta_t - \eta_n < 0$. This proves the derivatives of (3.11').

Derivation of (3.11)

Substituting $\hat{p}_t = \hat{p} - (1-k)\hat{z}$ into (I.11) produces

$$\hat{y} = \eta(\hat{w}-\hat{p}) + (1-k)(k(\eta_t - \eta_n) + 1)\hat{z}. \qquad (I.14)$$

An increase in the real wage ($\hat{w}-\hat{p}>0$) with relative prices constant leads to a reduction in total output because $\eta < 0$. An increase in z has ambiguous effects on output as before, unless $\eta_t - \eta_n$ can be signed.

Absolute and Relative Price Effects of a Change in z

Differentiate (3.11) in the text with respect to z and using (3.10)

$$\partial y/\partial z = S'_{w/p}\,(1-k)(w'-1) + S'_z \qquad \text{(I.15)}$$

assuming w = p = 1 initially. The absolute price effect involves the influence that an increase in z has on the price level. This is equal to the first term in (I.15) and is positive as long as $w' < 0$ and is zero for $w'=1$. The relative price effect, involves the compositional effect on output as one sector expands and the other declines. Its effect on total output depends on the sign of $\eta_t - \eta_n$ and hence the second term in (I.15), S'_z, is ambiguous.

APPENDIX II: Macroeconomic Performance With and Without Indexation

The One-Sector Model

The analysis is adopted from Gray (1976) and Assayag (1978). The aggregate supply equation is given by

$$y = x\, S\left(\frac{w}{p}\right) \qquad \text{(II.1)}$$

which is similar to (3.6) except that a random variables, x is introduced which has an expected value of one and a constant variance.

A simplified version of (3.1), the aggregate demand relationship, is written as

$$y = v\lambda \frac{M}{p} \qquad \text{(II.2)}$$

where v is a random variable with expected value of one and constant variance and λ is the constant velocity of the real money stock. Equating (II.1) and (II.2)and taking proportional changes of all variables, denoted by ($\hat{}$) we can solve for $\hat{p}$ and $\hat{y}$

$$\hat{p} = (\hat{v} + \hat{M} - \hat{x} - \eta\hat{w})/(1-\eta) \qquad \text{(II.3)}$$

$$\hat{y} = \left(\frac{\eta}{1-\eta}\right)\hat{w} - \frac{\eta}{1-\eta}(\hat{v}+\hat{M}) + \left(\frac{1}{1-\eta}\right)\hat{x} \qquad \text{(II.4)}$$

where $\eta = \dfrac{\partial S}{\partial\left(\frac{w}{p}\right)} \cdot \dfrac{\frac{w}{p}}{S} < 0$ is the elasticity of supply.

(a) Random Nominal Shock

For this case, all variables except $\hat{v}$ and $\hat{w}$ are set to zero on the right-hand side of (II.3) and (II.4). For indexation, $\hat{w} = \hat{p}$, without

indexation $\hat{w} = 0$ because the nominal wage cannot adjust to unpredicted price movements. The results of a positive shock to v are shown in Table II.1.

(b) Random Real Shock

In this instance only $\hat{x}$ is non zero. Assume that $\hat{x} < 0$ implying a random shift to the left of the aggregate supply curve. The effects of this on $\hat{p}$ and $\hat{y}$ are also shown in Table II.1

Table II.1

Summary of Results of Nominal and Real Shocks on Prices and Output, Without and With Wage Indexation in a One-Sector Economy

Shock	No indexation ($\hat{w}=0$) $\hat{p}$	$\hat{y}$	Complete indexation ($\hat{w}=\hat{p}$) $\hat{p}$	$\hat{y}$
Nominal ($\hat{v}>0$)	$\frac{\hat{v}}{1-\eta} > 0$	$-\frac{\eta\hat{v}}{1-\eta} < 0$	$\hat{v} > 0$	0
Real ($\hat{x}<0$)	$-\frac{\hat{x}}{1-\eta} > 0$	$\frac{\hat{x}}{1-\eta} < 0$	$-\hat{x} > 0$	$\hat{x} < 0$

The Two-Sector Model

For an SOE, we can analyse the effect of a random change in the relative price of nontradables, z.

(a) Fixed Exchange Rates

Equilibrium is described by the aggregate supply curve

$$y = S(\frac{w}{p}, z) \qquad \text{(II.5)}$$

and the equation for the price index

$$p = p_t + (1-k)z \qquad \text{(II.6)}$$

which repeat equations (3.11) and (3.10) in the text. Taking proportional changes, holding p_t constant, we obtain

$$\hat{y} = \eta_1(\hat{w} - (1-k)\hat{z}) + \eta_2\hat{z} \qquad \text{(II.7)}$$

$$\hat{p} = (1-k)\hat{z} \qquad \text{(II.8)}$$

where $\eta_1 = \frac{\partial S}{\partial(\frac{w}{p})} \cdot \frac{\frac{w}{p}}{S} < 0$ and $\eta_2 = \frac{\partial S}{\partial z} \cdot \frac{z}{S} = ?$ For a positive, random change in z, the effects on $\hat{p}$ and $\hat{y}$ can be calculated from (II.7) and (II.8). The results are summarized in Table II.2 for complete wage indexation $(\hat{w}=\hat{p})$ and its absence $(\hat{w}=0)$. The signs of the qualitative results are based on the assumption that the "relative-price" effect of z on y is positive (i.e., $\eta_2 > 0$).

(b) Flexible Exchange Rates

In addition to equations (II.5) and (II.6) we must impose the condition that nominal income is constrained by the money supply, so that dropping v from (II.2) produces

$$py = \lambda M \qquad \text{(II.9)}$$

Taking proportional changes of (II.9), (II.5) and (II.6), produces

$$\hat{p}_t + (1-k)\hat{z} + \hat{y} = \hat{M} \qquad \text{(II.10)}$$

$$\hat{y} = \eta_1(\hat{w} - \hat{p}_t - (1-k)\hat{z}) + \eta_2 \hat{z} \qquad \text{(II.11)}$$

which can be solved for $\hat{p}_t$ and $\hat{y}$ in terms of $\hat{z}$ with $\hat{M} = 0$. The results for $\hat{p}$ and $\hat{y}$ are reported in Table II.2, assuming again $\eta_2 > 0$.

Table II.2

Summary of Results of Relative Price Shock on Prices and Output, Without and With Wage Indexation in a Two-Sector Economy

Exchange Rate Regime	No Indexation ($\hat{w} = 0$)		Complete Indexation ($\hat{w} = \hat{p}$)	
	$\hat{p}$	$\hat{y}$	$\hat{p}$	$\hat{y}$
Fixed Rates ($\hat{p}_t = 0$)	$(1-k)\hat{z} > 0$	$(-\eta_1(1-k)+\eta_2)\hat{z} \gtrless 0$	$(1-k)\hat{z} > 0$	$\eta_2\hat{z} > 0$
Flexible Rates ($\hat{M} = 0$)	$\frac{-\eta_2}{1-\eta_1}\hat{z} < 0$	$\frac{\eta_2}{1-\eta_1}\hat{z} > 0$	$-\eta_2\hat{z} < 0$	$\eta_2\hat{z} > 0$

Let $\hat{y}^*$ be the proportional change in total output when complete indexation is used and let $\hat{y}$ continue to denote the change in output without indexation. Under fixed exchange rates, $\hat{y} > \hat{y}^*$ when $\eta_2 > 0$, otherwise the result is uncertain. Under flexible rates $\hat{y}^* > \hat{y}$ in absolute values whatever the sign of η_2.

APPENDIX III: The Incentives for Wage Indexation

Labour's utility function is represented by

$$U(Y) \tag{III.1}$$

with $U' > 0$, $U'' < 0$ to depict risk-averse behaviour.

$$Y = \frac{wN}{p} \tag{III.2}$$

For firms, the utility function is

$$V(\pi) \tag{III.3}$$

with $V' > 0$, $V'' < 0$ where

$$\pi = p_i q - wN - A \tag{III.4}$$

where p_i is the price of the particular firm's output, q, and A represents all fixed costs.

Pure Inflation

Uncertainty exists about the price level, but relative prices are not subject to random shocks. Without wage indexation, $w = \bar{p}$ where $\bar{p}$ is the expected price level. With wage indexation, $w = p$.

Using a Taylor expansion of (III.1) and taking expectation

$$E[U(Y)] = U(\frac{\bar{p}N}{p}) + \frac{U''}{2} \frac{N^2}{p^2} \sigma_p^2 \tag{III.5}$$

where σ_p^2 is the variance of p. With indexation, the utility for labour is $U^*(pN/p)$ because no uncertainty exists. Since

$$U^*(pL/p) > E[U(Y)]$$

labour unions have an incentive to demand indexation in an inflationary environment.

For firms, expected utility without wage indexation is

$$E[V(\pi)] = V(\bar{p}_i q - wN - A) + \frac{V''}{2} q^2 \sigma^2_{p_i} \qquad \text{(III.6)}$$

where $\bar{p}_i$ is the expected value of p_i and $\sigma^2_{p_i}$ is the variance. With indexation, firms face an additional uncertainty about the wage.

$$E[V^*(\pi)] = V^*(\bar{p}_i q - \bar{p}\, N - A) + \frac{V^{*''}}{2} (q^2 \sigma^2_{p_i} + N^2 \sigma^2_p - 2qN\rho\sigma_{p_i}\sigma_p) \qquad \text{(III.7)}$$

where ρ is the correlation between p_i and p. With pure inflation $\rho = 1$ and $\sigma_{p_i} = \sigma_p$ so that (III.7) reduces to

$$E[V^*(\pi)] = V^*(\bar{p}(q-N) - A) + \frac{V^{*''}}{2} (q-N)^2 \sigma^2_p \qquad \text{(III.7')}$$

Since $(q-N)^2 < q^2$,

$$E[V^*(\pi)] > E[V(\pi)]$$

As a result, firms favour indexation also.

Relative Price Changes

In this instance, commodity prices can change in different proportions so that p and p_i do not move together. For labour the incentive for indexation is unchanged. For firms the incentive becomes weaker. The last term in (III.7) is no longer smaller than the last term in (III.6), particularly if p_i and p move in opposite directions (i.e., $\rho < 0$). When

$$E[V^*(\pi)] < E[V(\pi)]$$

firms have a disincentive for wage indexation.

Real Uncertainty

Assume that uncertainty exists about the value of N. In this case wage indexation does not eliminate risk for either side. For labour

$$E[U(Y)] = U\left(\frac{w\bar{N}}{p}\right) + \frac{U''}{2}\,\frac{w^2}{p^2}\,\sigma_N^2 \qquad \text{(III.8)}$$

and for firms

$$E[V(\pi)] = V(p_i q - w\bar{N} - A) + \frac{V''}{2}\,w^2\,\sigma_N^2 \qquad \text{(III.9)}$$

where $\bar{N}$ and σ_N^2 are the mean and variance of the probability distribution of N. Substituting $w = \bar{p} = p$ in (III.8) and (III.9) does not change the expected values of utility. Neither side has an incentive for wage indexation.

APPENDIX IV: The Relationship Between Unemployment and Output

Differentiate $u(Q_t, Q_n)$

$$du = u_1 \, dQ_t + u_2 \, dQ_n \qquad \text{(IV.1)}$$

where $u_1 = \partial u/\partial Q_t < 0$ and $u_2 = \partial u/\partial Q_2 < 0$. If the capital requirements per unit of Q_t are the same as those of Q_n then Q_n is labour intensive if $u_2 < u_1$.

Substitute $$dQ_t = dy - z dQ_n - Q_n dz \qquad \text{(IV.2)}$$

into (IV.1) to obtain

$$du = u_1 \, dy - u_1 \, Q_n \, dz + (u_2 - z u_1) \, dQ_n$$

so that $du/dy < 0$, $du/dz > 0$ and $du/dQ_n < 0$ if $u_2 < u_1$ and $z = 1$ initially.

APPENDIX V: The Effect of Expansionary Monetary Policy on Output and Inflation

(a) The Impact Effect

Differentiate (6.15) and (6.16) with $d\dot{G} = 0, d\dot{M} = -d\dot{B}, d\dot{\bar{p}} = 0, d\dot{c} = 0$ and the composition of output constant.

$$\begin{bmatrix} 1 & m+s \\ -b \cdot u_y' & 1 \end{bmatrix} \begin{bmatrix} dy \\ d\dot{p} \end{bmatrix} = \begin{bmatrix} (m-s)d\dot{M} \\ 0 \end{bmatrix}$$

$$dy = \frac{1}{\Delta} (m-s)\, d\dot{M} > 0, \text{ because } m > s$$

$$d\dot{p} = \frac{1}{\Delta} (m-s)\, bu_y'\, d\dot{M} > 0$$

where $\Delta = 1 + (m+s)\, b\, u_y' > 0.$

(b) Equilibrium Effect

In this case $\dot{p} = \dot{\bar{p}}$ and

$$dy = 0$$

$$d\dot{p} = d\dot{M}.$$

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